DOCUMENT RESUME

ED 304 808 EC 212 298

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TITLE Reading Comprehension II. Bibliographies and Summaries of Selected Articles. Volume 6. Research Review Series.

INSTITUTION Columbia Univ., New York, N.Y. Research Inst. for the Study of Learning Disabilities.

SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.

PUB DATE 79

CONTRACT 300-77-0492

NOTE 115p.; For volumes 1 and 2, see EC 212 296-297.

PUB TYPE Information Analyses (070)

EDRS PRICE MF01/PC05 Plus Postage.

DESCRIPTORS Artificial Intelligence; Cognitive Processes; Educational Diagnosis; Elementary Secondary Education; Handicap Identification; Instructional Effectiveness; *Language Skills; *Learning Disabilities; Linguistics; Memory; *Reading Comprehension; *Reading Difficulties; Reading Instruction; Schemata (Cognition); Student Evaluation; Teaching Methods

ABSTRACT

Summaries of several papers are presented to develop a working theoretical analysis of reading comprehension and an understanding of development in language comprehension based upon empirical studies. Contributions from the areas of assessment, artificial intelligence, cognition (including schema theory), instruction, linguistics, learning disabilities, and memory are included. Articles summarized include, among others: "Failures to Comprehend and Levels of Processing in Reading" (M. Adams); "Schemata as Scaffolding for the Representation of Information in Connected Discourse" (R. Anderson et al.); "Perceptions, Thought, and Language" (T. Bever); "Children's Comprehension of Between- and Within-Sentence Syntactic Structures" (J. Bormuth et al.); "Defining Language Comprehension: Some Speculations" (J. Carroll); "Creativity in Verbalization and Its Implications for the Nature of Stored Knowledge" (W. Chafe); "Maintenance and Control in the Acquisition of Knowledge from Written Materials" (L. Frase); "Semantic Processing Units in Understanding Text" (C. Frederiksen); "On Relational Meaning: The Acquisition of Verb Meaning" (D. Gentner); "Toward a Functional Theory of Discourse" (R. Hurtig); "Comprehension and Recall of Text as a Function of Content Variables" (W. Kintsch et al.); "Remembrance of Things Parsed: Story Structure and Recall" (J. Mandler); and "The Organization of Prose and its Effects on Memory" (J. Meyer). (JDD)

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READING COMPREHENSION II

Walter H. MacGinitie, Joanna P. Williams
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Research Review Series 1979
Volume 6

EC 212298

Funded under OE/BEH Contract Number 300-77-0492

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READING COMPREHENSION II

BIBLIOGRAPHIES AND SUMMARIES OF SELECTED ARTICLES

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Research Review Series 1979
Volume 6

Series Editor, Elizabeth Neuman

Funded under OE/BEH Contract Number 300-77-0492

Interest in the area of reading comprehension is burgeoning. As a result, the literature in this area is both large in scope and diffuse. To aid us in developing a working theoretical analysis of reading comprehension and in developing an understanding of development in language comprehension (including reading comprehension) based upon empirical studies, we have developed two bibliographies. We have also selected some of these papers which we consider of special interest and have prepared lengthy summaries of them. These summaries represent the theoretical positions and the empirical studies of a wide variety of investigators currently working in the field. Contributions from the areas of assessment, artificial intelligence, cognition (including schema theory), instruction, linguistics, learning disabilities, and memory are included.

Most of the research in the area of comprehension has been done with adult subjects. Only a few of the investigators employed children, and even fewer studied learning disabled children. In addition, we found only a few studies that used the same methodological approach and content across two or more age groups or ability levels. Many of the research studies cited have considered the effects of text characteristics upon recall; others have considered memory for text as a function of the instructions given to the readers, the reader's purpose and previous knowledge.

Adams, M. J. Failures to comprehend and levels of processing in reading. In R. J. Spiro, B.C. Bruce & W. F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, N. J. : Lawrence Erlbaum, 1978.

The assumption underlying this study is that skilled reading depends upon perceptual, linguistic and cognitive processes. Reading difficulties reflect inadequate development of one or more of these processes. Adams' purpose is to consider some of the processes that may be especially problematic for the young reader. Skilled reading is thought of as a product of both analytic and synthetic, or bottom-up and top-down activities.

Overview

Information is propagated upwards through increasingly comprehensive levels of analysis (letters →words identified →syntactic and semantic structures primed). This is called bottom-up processing. While this is happening the partially activated candidates at each level are competing for completion; as they do so, they reciprocally prime or facilitate the processing of their missing elements. This is called top-down processing. For the skilled reader, top-down and bottom-up processing are occurring at all levels of analysis simultaneously. Top-down processes ensure assimilation of lower order information that is consistent with the reader's expectations. Bottom-up processes ensure that he will be sensitive to any information that is novel or that does not fit his ongoing hypotheses about the contentof the text. Efficient operation of such a system depends equally upon information in the reader's mind and information in the written text. If the reader lacks critical skill or knowledge he must compensate by either directing extra processing energy (e.g., articulating a particular word) or by relying on top-down processes to evade the problem (e.g., use contextual information to infer meaning of an unfamiliar word). The beginning reader may fail to adopt either strategy, or, equally serious, may adopt either to an extreme.

If the reader relies too heavily on top-down processing there may be too much guessing. If he focusses too much on the difficulty of words he will face the problem of selectively directing attention to a subprocess, thus taking it away from deeper levels of analysis (LaBerge and Samuals, 1974). Children have limited functional memory capacity, thus making the attention they focus on a subprocess even more detrimental. Some possible explanations for their reduced memory capacities are that (1) the span increases with age, (2) children fail to "chunk" or organize material for efficient storage and (3) it reflects the differential effort children invest in encoding information to be remembered. Craik and Lockhart (1972) suggest two other factors which may divert attention from meaningful levels of analysis. One factor is the nature of the materials: materials intended to support comprehension in beginning texts must be chosen with careful consideration of the knowledge and interests of their young readers. A second factor is the nature of ostensible task demands: if the encoder is instructed to focus on nonmeaningful aspects of a stimulus, he will do so.

True reading is possible only if the whole complex of subprocesses are functioning easily and in proper coordination. If any process requires undue attention, comprehension will suffer. Skilled readers will find effective ways to overcome their difficulty. The beginning readers must learn how to overcome difficulties without forfeiting meaning of text.

Word Recognition

Perfetti and Hogaboam (1975) found that more skilled comprehenders can recognize a word faster than less skilled comprehenders (especially with less frequent or unfamiliar words). Poor readers rely heavily on initial parts of words and fail to synthesize cues from medial and final positions. They are also less sensitive than good readers to the spatial redundancy of English orthography and are less facile with the spelling-to-sound correspondences of English. In addition, comprehension suffers if too much attention has to be given to decoding (Perfetti, 1975).

Another means of coping with visually unfamiliar words is to use the syntactic and semantic constraints of text to guess word identity. Thus, processing at higher levels may compensate for decoding difficulties. This is a normal aspect of skilled reading. Recent studies suggest that even for young children, reading is a generative, topldown process. Perfetti (1975) demonstrated that children's ability to read is facilitated almost as much by their having heard the word before as by their having heard and seen it before. Weber (1970) showed that first graders' substitution errors during oral reading are more strongly controlled by the syntactic and semantic constraints of the text than by the graphemic cues of the mistaken words. Wittrock, Marks and Doctorow (1975) found that children are better able to process unfamiliar words if they are embedded in a familiar as opposed to an unfamiliar story. Biemiller (1970) found that graphemic substitutions increased toward the end of the first year of school. Children apparently find it easier to guess than to decode.

Top-down processing becomes a hindrance when it is used to avoid decoding altogether. Kolers (1975) found that the use of top-down processing to avoid decoding may be a fairly common source of reading difficulty among older children. Poor readers were relatively insensitive to graphemic or typographic aspects of the stimuli. For the skilled reader, top-down and bottom-up processes operate as complements rather than substitutes for one another. According to Adams, this can only happen when word recognition processes are overlearned.

Syntactic Processing

In a real world context the interpretation of any utterance is aided by the tone and stress patterns of the speaker. These cues are not present in written language. Reading presumes a level of syntactic proficiency that is not required for listening. Processing differences between reading and listening extend beyond the level of word recognition; unless the reader can recover or construct the syntactic structure of the printed sentence, it doesn't matter whether he has the syntactic competence to understand it. Cattell (1886) and Schlesinger (1969) found that skilled readers take in whole phrases at a glance and their glances are programmed to do so. How then does the reader coordinate his visual fixations with the phrase structure of the text? Given that peripheral acuity is quite poor, one explanation is that the reader's fixations are primarily controlled by his hypotheses about what he is about to read. In keeping with this, the amount of information a person can recite after the text is taken away increases with the syntactic and semantic predictability of the passage (Lawson, 1961; Norton, 1964a, 1964b).

Marcell (1974) demonstrated the interfacilitation between top-down and bottom-up processes. Increased contextual constraint led to a disproportionate increase in the number of errors that were simultaneously grammatically and visually acceptable; thus, it apparently increased the visual angle at which the subjects could discern graphical details of the printed information. According to Miller (1956) the limits of a reader's active memory capacity would be exceeded if the reader did not recode connected discourse at syntactic boundaries.

Kleiman (1975) suggested a model in which the reader proceeds through the text and enters each word into his short-term memory buffer. After each word is entered, the reader checks to see whether or not it completes a constituent structure. If not, he proceeds to the next word. As soon as he thinks he has completed a phrase, the contents of the buffer are recoded or collapsed into a composite meaning complex. He now checks to see if the sentence has been completed. If not, he starts working on the words of the next synyactic unit. If yes, the contents of the short-term buffer are transferred to long-term memory and he is ready for a clean start on a new sentence. Semantic variables normally contribute heavily to syntactic processing but are not always sufficient (Higgins, this book). Using meaningful materials, Cromer (1970) has shown that the reading comprehension of some poor readers can be improved by superficially demarcating phrasal boundaries. Weaver (1977) improved syntactic awareness in third graders by teaching them to solve sentence anagrams.

Reading requires syntactic awareness that is generally not required for listening. If the reader lacks competence to organize written material into syntactic constituents, comprehension and memory will suffer. Initial textbooks do not contain difficult syntactic structures and, therefore, the problem may not be apparent until later on, and may be difficult both to detect and to correct.

Semantic Processing

In order to understand text, the reader must recognize words and alyze syntax. Also, he must access and organize the appropriate conceptual knowledge. This depends on a variety of semantic knowledge and processes. There are roughly two classes of difficulty at the semantic level: (1) the completeness with which a reader can map the meaning of the text onto his own conceptual structures, and (2) the reader's ability to usefully organize the meaning of the passage. Other impediments to the mapping process are: lack of world knowledge, lack of appreciation of pragmatic dimensions of discourse (Bruce); differences between the dialects of the child's reading materials and his oral language environment (Hall); difficulties in coordinating references (Nash-Webber); difficulties with polysemy, metaphor, and figurative language (Ortony); and difficulties in appropriately altering his point of view (Rubin).

Any of these difficulties may arise from an unfamiliarity with the words or linguistic devices by which meaning is expressed or a lack of concepts signified by the text. According to Adams, these two sources are not independent since the child's linguistic sophistication is bounded by his conceptual sophistication. As an example of this, she cites an experiment by Bradshaw and Anderson (1968) in which the use of the adverbial modifiers slightly, somewhat, rather, pretty, quite, decidedly, unusually, very and extremely, was studied from first grade through adulthood. The meanings of these words were acquired gradually, not until fourth or eighth grade in some cases. This discrepancy is attributed not to an inability to conceptualize relative differences in quantity, but to the need for a great deal of exposure prior to detecting the subtle semantic differences.

While vocabulary is the single best predictor of reading comprehension, Adams points out that this may be because both depend on the child's general language experience. In addition, vocabulary and conceptual ability are related; since word meaning depends upon an understanding of the corresponding concepts (Nelson, 1974). Words seem to be learned according to their complexity, with simpler ones being acquired first (Genter, 1975). For example, trading entails giving and taking, and is thus more complex than either one, and is learned subsequent to them. Moreover, the acquisition of a complex word implies an understanding of the simpler concepts.

Sinclair-de Zwart (1969) has shown that the acquisition of syntactic structures may depend on the child's level of cognitive development. The children who could conserve were able to describe objects contrastively. Teaching the children descriptive words did not aid their performance. Adams points out that the close temporal correlation between logical and linguistic skills is probably due to the acquisition of a common conceptual structure.

The second class of semantic problems, which has to do with the reader's ability to organize concepts in a text, is also crucial to comprehension. When the thematic structure of a passage is obscrued, both memory and comprehension are impaired (Bransford and Johnson, 1973; Bransford and McCarrel, 1974; Frase, 1972). In order to comprehend the passage, the reader must be sensitive to the relative importance of various concepts introduced in the text. Adult recall of connected discourse shows strong evidence of ideational scaffolding (Johnson, 1970); Bransford and McCarrell, 1974; Darling and Lachman, 1971; Spiro, 1976). Brown and Smiley (1977) have found that the same organizational tendency exists in young readers. Smiley et al. (1977) using both reading and listening, found that sensitivity to gradations in the importance of ideational units is quite poor among beginning readers and increases only gradually with reading experience. Insensitivity was also found among older, poor readers. This highlights the need to teach children to recognize the relative importance of the ideas in discourse.

Hershberger and Terry (1965) drew essential concepts in red, while Rothkopf (1972) used adjunct questioning. Both researchers found that readers tended to remember highlighted information better. Adams, however, raises the question of transfer of learning. Adams suggests that it might also be useful to point out to young readers the structural and stylistic features that correlate with the thematic significance of the units in a text (Meyer, 1975). Again, the question of transfer is raised. The optimal reading strategy will depend upon the nature of the passage and upon the reader's intention for reading it (Fredericksen, 1975). Adams suggests exposing the child to a variety of texts and goals, and teaching the selection and implementation of a variety of analytic strategies.

The problems in comprehension discussed here affect both reading and language. According to Adams, these problems are exacerbated in the reading situation which lacks the flexibility of oral dialogue.

Anderson, R. C., Spiro, R. J., & Anderson, M. C. Schemata as scaffolding for the representation of information in connected discourse. (Tech. Report No. 24). Urbana, Ill.: Center for the Study of Reading, University of Illinois, March 1977.

The purpose of this report is to provide a clear formulation of schema theory. and an experimental test of some hypotheses that follow from the theory.

A schema will contain slots into which some of the specific information described in a message will fit. Information that fits the superordinate schema is more likely to be learned and remembered, perhaps because there is a niche for it. It follows that one schema can provide slots for more of a certain fixed body of information than other schemata. If the knowledge domain were specified, it should be possible to make qualitative as well as quantitative predictions about just which details will be learned.

Subjects, 75 undergraduates, were requested to write down as much as they could recall about a passage they were given to read, in the same order etc., after a short delay. Half of the subjects read a passage about activities in a restaurant, the other half read about the same or very similar activities in the same order but in the context of a supermarket shopping expedition. Eighteen food items were mentioned in the same order in the two narratives.

They found that food from categories determined to be part of most people's restaurant schemata were better recalled by subjects who read the restaurant narrative; subjects who received the restaurant narrative were more likely to recall the character to whom a food had been attributed; contrary to expectation, subjects were equally likely to reproduce food order information no matter which passage they had read. (A few subjects who read the supermarket narrative said they imagined a dinner party being prepared for.) Information of the same significance in the context of either the restaurant or supermarket story was equally well recalled by the two groups. The authors conclude that high-level schemata play a role in the learning and remembering of text information.

One hypothesis is that schemata provide the "ideational scaffolding" for text information. According to this hypothesis, a high-level schema provides slots for selected categories of text information: if information fits a slot it will be instantiated as part of the encoded representation for the text.

Another hypothesis is that high-level schemata help the reader determine which are the important text elements; the reader's attention is directed to the elements that have been singled out, and it is for this reason that such elements are better learned.

Both the slot-filling and attention-directing explanations suppose processes acting when a passage is read.

It is possible that schemata support processes at work later, when information is being retrieved: the schema could provide a retrieval plan (Pichert and Anderson, 1977; Bower, 1977). Or, a schema may help a person recover information by "inferential reconstruction" (Spiro, 1977), for example, if one remembers beef as the entree, but does not remember a beverage, red wine would become the candidate beverage. Candidates may be produced as plausible guesses. Or, once a candidate is generated it may be verified against an otherwise weak or inaccessible memory trace.

The authors argue against Ausubel's (1963, 1968) "advance organizers" which outline material to follow in abstract, inclusive terms, because they find it to see how outlining subsequent material in this way helps readers. They argue that when the reader possesses relevant subsuming schemata he/she will routinely bring them to bear, and when the reader does not possess relevant schemata, there is no good reason to suppose that he/she can acquire them from a few abstractly worded sentences (Anderson, 1977).

One implication for education is that the schemata that will allow him to make sense but will not permit mental representations of great depth or breadth. Little is known about how a child might develop new high-level schemata, at least from reading.

Bever, T.G. Perceptions, thought, and language. In J.B. Carroll & R.O. Freedle (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C.: Winston, 1972.

Bever examines the relation between thought and language in the light of recent linguistic and psychological investigations of sentences and presents two complementary hypotheses: (1) cogntivie and behavioral systems constrain certain linguistic structures; and (2) syntactic style (personal, ethnic, and linguistic) systematically modifies certain concepts.

Language structure is molded by an interaction of the laws of thought, learning, speech perception, and speech production. This paper focuses on the influence of the mechanism for speech perception on linguistic structures. If the structure of language does affect thought, then speakers of different languages with different structures must have different concepts. Nevertheless, it does not appear to be impossible to translate basic concepts from one language to another; there is only an occasional difference in the perceived completeness and directness of expression. If language does not affect thought, why do bilingual speakers feel that true translation of concepts is impossible?

To resolve this, Bever distinguishes between semantic meaning and linguistic ideas. While linguistic structures may determine certain features of linguistic ideas embedded in concepts, these features are not necessarily critical components of the semantic meanings of the concepts. Semantic meaning specifies the minimal information required to account for the synonymy, antonymy, and entailment of relations with other concepts. Cultural ideas describe the nonsemantic aspects of a concept which may be a regular function of the role of the concept in the culture, but which are not critical to the semantic meaning. (For example, the term stewardess in the 1950's implied a young, unmarried female.) Highly regularized expressions of a culture are termed linguistic ideas by Bever, while personal ideas are the penumbra of personal experiences surrounding the cultural and semantic ideas in a concept.

A problem for a theory of acquisition of meaning is how does a child learn what is semantically critical to the concept and what is simply his own personal or cultural experience? According to Bever, one cannot say that linguistic meanings are individual ideas about word meanings which we all share - e.g., the concept of a stewardess has changed from the 1950's, yet the changed features are not critical to the semantic meaning. Bever presents the following points: (1) our thinking partially determines the structure of speech perception; (2) the mechanism for speech perception is constrained by other variables, such as the fact that it must operate in real time; (3) these properties of perceptual mechanisms restrict the kinds of linguistic sentences possible to those that are decodable; (4) a sentence conveys by its cultural idea content the emotional and perceptual operations occurring during its perception; (5) if certain kinds of orders are unavailable in a particular language, then so are the corresponding ideas that would result from the perceptual operations applying to those orders (for example, the following sentence is not really meaningful in English: "The metal nice red box."); (6) the linguistic structure puts some limits on easily coded cultural ideas; which in turn (7) constrain the kind of concepts which we manipulate. Thus, thought influences perception, perception influences language, and the structure of language influences the way we think about what we think about.

The Structure of Speech Perception

A basic assumption regarding thinking is the distinction between activities involved thinking and the storage of previously acquired knowledge. The role of mental activities is to bring units into relation to each other, and the role of store is to retain plans and schemata for carrying out such activities. The mechanism of speech perception must isolate units and construct relations between units.

Linguistic units are "designating phrases," while relations include "semantic" concepts such as actor-action, action-object, modification, etc. Various researchers have proposed an "analysis by synthesis" moden of perception in which the grammar is used to generate candidate sentences to "match" the input. This would be preceded by a "preprocessor" which guides a grammar to guess efficiently. Three principal features of speech perception within the preprocessor are: (1) the clause is a primary perceptual unit; (2) within each clause, direct mapping rules assign semantic relations between major phrases; and (3) after each clause is processed, it is recoded in relatively abstract form, leaving immediate storage clear for the next clause.

Research suggests that during a clause a listener isolates major phrases and projects a possible internal organization for the semantic relations between the phrases. At the end of each clause a structure is assigned, and the external form of the clause itself is erased from immediate memory.

The Influence of Speech Perception on Linguistic Universals

As Bever points out, linguists have been concerned with the extent to which certain language universals are due to perceptual principles rather than to universal grammatical principles. For example, English grammar allows for the generation of sentences 100 words long; however, behavioral constraints make such sentences improbable. Moreover, linguistic rules appear to be formed in accordance with behavioral constraints: in English, listeners are never presented with an initial clause without knowing whether it is the main or subordinate clause of the entire sentence; in addition, the more specific an adjective is, the closer to the head noun it must appear. For various reasons, each language limits stylistic options available to speakers to vary the order in which concepts are presented and restricts the order in which the corresponding perceptual operations can apply.

The Influence of Perceptual Order on Concepts

Bever proposes that perceptual activities are contained in concepts as part of our cultural ideas about linguistically defined meaning and consequently are one part of the concepts that contain the meanings. For example, if the standard order of clauses or prenominal modifiers is constrained in a particular language, then this in turn constrains the expected order of these constituents and the kinds of emotional tensions that can be created when the order is either followed or violated. A concrete example follows :

John loves his mother, surprisingly.
Surprisingly, John loves his mother.

In English, speakers are limited to hearing the more specific adjectives later in a series of prenominal adjectives and, thus, are denied the ideas communicated by allowing adjectives to appear in decreasing order of specificity. Prenominal adjectives are always in the orders of evaluative first, then size, and then material last, but phrases such as metal nice red box can occur in English in that order postnominally as in "the box that is metal and nice and red". Bever argues that there is a psychological difference between the prenominal and postnominal positions of modifiers, e.g.,

I'm thinking of something. It's nice. It's red. It's large. It's a box.
I'm thinking of a box. It's nice. It's red. It's large.

Codability and Thought

Bever restates the Whorfian hypothesis to include the role of grammatical patterns in limiting thought: the syntactic structure of a language partially determines the kinds of concepts available to speakers, by limiting systematically the shared perceptual operations that can occur in the course of analysing the semantic meanings. He suggests that the ease with which we can process various meanings is influenced by the language that we use, but the possible occurrence of meanings is not necessarily limited by the language we use. This is unlike the Whorfian hypothesis that language determines forms of thought. The question arises of whether order constraints limit the kinds of sentence meanings that we can have: Do the cultural and personal ideas that are included with meanings in concepts modify the meanings themselves? According to Bever, the answer is negative for both word and sentence meanings. He points out that meanings and cultural ideas intersect as components of concepts in independent domains.

Bormuth, J. R., Manning, J., Carr, J. & Pearson, D. Children's comprehension of between- and within-sentence syntactic structures. Journal of Educational Psychology, 1970, 61, 349-357.

The purpose of this study was to identify language-comprehension skills, determine if the skills identified represent the same type of behavior, arrange the skills hierarchically, and test fourth graders in respect to these skills. There were four variables. First, 25 syntactic structures which seemed most difficult for fourth graders from Bormuth, 1970 and Mengel, 1970 were used. (For example, subordinate sentence, after as in "After we entered, the play began.") Second, 14 types of anaphora were examined (see Table 3). An anaphoric expression replaces another expression which is generally antecedent to it. Pronouns are one type, the expression this is another, as in the following sentence: "The small boy rode the horse. This boy is a good rider." Third, 16 categories of intersentence syntactic structures were studied (see Table 4). The order in which sentences are presented determines the type of inferences possible. Consider the sentence: "The boy fell off the horse. He broke his arm." This sentence indicates that the fall resulted in a broken arm. When these sentences are reversed, they might signal "The boy's breading of his arm caused his fall from the horse." A few other examples of intersentence syntactic structures are as follows :

Effect :	The gear slipped off. The machine stopped.
Cause :	The machine stopped. The gear had slipped off.
List :	Three came. Joe, Bill and Mary were the ones.

Finally, 4 question types were used to measure comprehension of the structures examined. (a) Rote questions which are derived by deleting one member of the structure and replacing it with the appropriate wh-pro word. (b) Transform questions which are derived by first deriving a mediating sentence and then deriving a rote question from the mediating sentence. Example of a mediator sentence, "It was the boy who rode the steed." or "The steed was ridden by the boy." (c) Semantic substitute question in which one or more synonymous terms are substituted for the term in the original sentence. (d) Compound questions which represent questions derived by applying both the semantic substitute and the transform operation to sentences. Examples of the four sentences. Examples of the four sentence types :

Original sentence	The boy rode the steed.
Rote	Who rode the steed?
Transform	By whom was the steed ridden?
Semantic substitute	Who rode the horse?
Compound	By whom was the horse ridden?

Examples of an anaphora comprehension question and an intersentence syntax question :

Original sentence	The boy fell off the steed. He fractured his arm.
Rote (Anaphora)	Who fractured his arm?
Rote (Intersentence)	What caused the fracturing of the boy's arm?

Materials: Two different sentences or sentence pairs were incorporated into a paragraph of four or five sentences in length. Dale - Chall (1948) readibility was estimated to be fourth grade. Each passage had one question beneath it. The response format, for anaphoric questions only, was a multiple choice format. Subjects wrote their own answers in response to the other questions. The subjects were 240 fourth graders from semirural schools.

Results: The percentage of students responding correctly to each structure was scored. Percentages were averaged across sentence types. A two-factor, 4 question-types x 25 structures analysis of variance was conducted. Between-structure variance was significant for the 25 sentence structures: most students (88.3%) responded correctly to questions testing comparative, unequal as in "Joe runs faster than Bill". The sentence structure which received the least percentage of correct responses was comparative, equal as in "Joe runs as faster as Bill"; only 28.1% of the students responded correctly here. Between-question variance was also significant. The order of question difficulty, from easiest to hardest, is as follows : rote questions, transform questions; semantic substitute questions, and compound questions. The means correct are .77, .71, .69 and .67 respectively. Interaction was not significant. Between-structure variation for anaphora was significant as well. The greatest percentage of students (86.8%) responded correctly to questions testing Pro-clause, so, such as, "Joe may go. If so, we will...." Personal pronouns such as "Joe left the room. He had ..." ranked lowest with only 64.5% of the students responding correctly to questions which tested this anaphoric structure. Neither between-question type variation nor interaction was significant.

In addition, analysis of the intersentence category of syntactic structures showed between-structure variation was significant. Most students (79%) responded correctly to questions testing effect as in "The gear slipped off. The machine stopped." Few students (33%) responded correctly to questions testing after as in "Joe found the others. He had looked everywhere for them." Neither between-question type variation nor interaction was significant.

Differences between the categories of structures were also detected. The mean percentage of the students correctly answering the sentence comprehension questions was 73%; the mean correct for anaphora comprehension questions was 77%; and mean correct for the intersentence questions was 58%. Questions which tested intersentence categories of questions were significantly more difficult than questions on a single sentence and anaphoric questions.

Discussion: The most surprising result was the large number of fourth graders who did not display comprehension of basic syntactic structures used to signal information. (That anaphora comprehension questions were easier than sentence comprehension questions may be attributed to the fact that anaphora questions were followed by a multiple choice task which in the other task situations subjects had to write down their own answers). The authors are against using a competence/performance distinction hypothesis to explain the overall poor scores found here.

Carroll, J. B. Defining language comprehension: Some speculations. In J.B. Carroll & R. O. Freedle (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C. : Winston, 1972.

Language comprehension is difficult to measure and define, partially because certain comprehension tasks simultaneously tap, and are affected by, long term memory, and partially because comprehension often involves inference and related reasoning processes, which tend to measure general verbal intelligence and reasoning skills rather than comprehension per se. As a preliminary characterization of language comprehension, Carroll suggests that it entails first, the apprehension of linguistic information, i.e., in a given sentence and secondly, it requires that the information be related to whatever context is available at that time.

The testing of comprehension, then, involves considering two stages of the comprehension process: (1) the extent to which the individual "correctly" apprehends the purely linguistic information that is "committed" to the message and (2) the extent to which he "correctly" relates that information to some wider context. In addition, comprehension tests should be : (1) Valid: Ideally, tests should measure comprehension without simultaneously measuring processes such as memory, inference, guessing, etc. (2) Reliable: There should be consistent outcomes. (3) Generalizable: Measuring procedure should apply to (a) all types of verbal material (materials which vary in complexity) and (b) all classes of individuals (differing in age, and competences). (4) Convenient and practical: They should be easy to prepare, administer and score.

Carroll cites a variety of procedures for testing comprehension. One way is through subjective reports. Such a method may be helpful in determining which aspect of a message is causing difficulty (certain words, clauses or grammatical constructions). Subjective reports may yield false positive results but are unlikely to yield false negative results. In addition, if reports immediately follow the message, or are simultaneous with it, memory has little influence. Inferential comprehension will be reflected only to the extent to which it is required. Such a method cannot, of course, be used in adversary testing situations.

2. Reports of truth or falsity, or of equivalence with another presentation is another way of testing comprehension. With this method, it is more likely that comprehension will be measured if verification is based upon an analysis of the message or upon a pictured referent than if verification is based upon acquired knowledge. Wason (1961) used such a technique in studying negation. He required subjects to judge the veracity of statements, such as "88 is not an even number." Gough (1965, 1966) required his subjects to compare sentences to illustrations. This technique, for measuring comprehension can also be used to compare two passages similar in content but differing in syntax. In some extent this has already been done in vocabulary tests and multiple choice comprehension tests. Carroll points out that the simple binary (true/false) judgments may be unreliable measures, necessitating additional measures such as replication, feedback, correction and the like.

3. In yet another technique, the subject is provided with verbal directions

and is expected to perform the given task accordingly (nonverbal responses to a message: following directions). Carol Chomsky (1969) used such a technique in measuring children's understanding of certain verbs. This technique will be valid only if the task cannot be performed without understanding the instructions. In addition, a child may have understood the directions but may not remember them long enough to carry out the task. In general, this technique could be highly valid, reliable and convenient.

4. Supplying missing elements in messages - introduced by Taylor (1953) and also known as the "cloze" procedure - is another procedure for measuring comprehension. With this method, every fifth word or specially selected words are detected and the reader is required to fill them in. According to Carroll, the validity of this technique, as a measure of comprehension, is open to question: cloze passages seem to measure the redundancy of text or the ability to supply a word based upon linguistic cues. Coleman and Miller (1968) used the "progressive cloze" procedure to measure information gain. With this procedure, the subject must guess each successive word of a passage. They allowed their subjects to read the completed text first, and then provided them with the same passage under cloze conditions. Carroll argues that this technique involves memory and is not, therefore, a measure of pure comprehension.

5. Answering questions based on the message. With this technique paragraphs are generally left in front of the reader, if it is a reading task. In listening tasks, the questions generally follow the message and the subject must rely on memory. Test scores arrived at through this method have shown a high correlation with measures of general verbal ability. Carroll points out that precautions which would avoid chance guessing are often not taken. In addition,

some questions can be answered on the basis of prior knowledge while others may present difficulties extraneous to the comprehension of the text itself. Bormuth (1970) suggests a systematic procedure for item-construction based upon principles of transformational grammar. Such a procedure for item construction, Carroll believes, would be useful in measuring a reader's skill in apprehending information provided by linguistic cues. He is less certain as to its usefulness in measuring all aspects of comprehension.

6. Another technique requires the subject to select a familiar text from an array of "old" and new texts sometime after reading the original passage (recognition of messages, or elements thereof, on subsequent presentation). This method has been used to study comprehension by Clifton, Kurcz and Jenkins (1965), and Clifton and Odom (1966). Their new sentences consisted of grammatical transformations (such as, negative, passive, and grammatical transformations) of the old sentences. Lee (1965) and Fillenbaum (1966), among others, used such a technique to study memory for verbatim and semantically similar sentences. In general, verbatim forms are remembered only for a short time while sentence meaning is remembered for a much longer period.

Carver (1970) has introduced a "chunked comprehension test." Subjects are presented with a passage which is then rewritten and presented as a list of clauses, one of which has been altered. The altered clause fits in both semantically and syntactically so that readers who have not read the original do not choose the altered clause much above chance. Carroll considers this to be a test of memory rather than comprehension.

7. The reproduction of a message, in whole or in part, in original form or in

some transformation has also been used to assess comprehension. With this technique, again, memorh will be involved to varying degrees. This technique has been used within a verbatim recall paradigm by Terman (1916) to determine mental age in terms of recall for sentences, and by Slobin & Welsh (1968) in studying the development of linguistic competence in children. Gomulicki (1956) used such a technique and found that actor-action-effect sequences were recalled best. One variant of this technique is the paraphrasing task. In order for paraphrasing to be useful, there must be a systematic technique for scoring paraphrases. Another variant is the "eye-voice" span used, for example, by Levin and Kaplan (1970). The subject reproduces that part of text which he has visually processed, but has not yet read aloud, upon termination of the original stimulus. This may reflect the additional processing which occurs while the subject is reading aloud, though Carroll points out that this technique may also reflect the inferential processes depicted by "cloze" tests.

In summary, there is no one technique for measuring comprehension: inference, memory, prior knowledge, etc., almost invariably play a role. Carroll suggests controlling these factors through variation of message characteristics, control of temporal factors, and instructions to subjects. Though Carroll is interested in examining the apprehension of linguistic information, and the way that information is related to a wider context, techniques to distinguish between these two aspects of comprehension have not been developed yet.

Chafe, W. L. Creativity in verbalization and its implications for the nature of stored knowledge. In R. O. Freedle (Ed.), Discourse processes: Advances in research and theory. Vol. 1. Discourse production and comprehension. Norwood, N. J.: Ablex, 1977.

Chafe is concerned with the verbalization of an image stored in long-term memory (i.e., an accident). By verbalization, Chafe refers to those processes by which nonverbal knowledge is turned into languate. Verbalization is creative in that it requires the speaker to make choices among a variety of available options. Chafe's assumption is that verbal output differs from initial non-verbal input from memorh as exemplified by the fact that people rarely describe the same event the same way twice. Also, discontinuity exists between what the speaker "has in mind" and what he actually says.

One reason for this discontinuity is that experience is tied to particular events involving particular people, places, and times. It is impossible for language to communicate every unique event in a unique way, and therefore particulars are interpreted as instances of types. A speaker must decide how to assign particulars to types so that their verbal output will be effective. There are three kinds of types, and they are: schemata, frames and categories. Another reason for this discontinuity is that language requires a speaker to "propositionalize" knowledge which is stored not only in nonverbal but even in nonpropositional form. Choosing schemata, frames and categories requires that one match the internal representations of particular events and individuals with internally represented prototypes. The match between the particular and a prototype is a matter of degree. Since matching generally takes place during verbalization and not before, it cannot be relegated wholly to the stage of perception or storage.

Schematization

Experience is recalled in "chunks" with varying degrees of content, interrelated in various ways. Chunks are basic units of memory for particular incidents and events. A person who remembers an event has it in totality before him in some sense and may give a summary verbalization, for example, "Let me tell you about my accident last week." If a speaker wishes to say more he must organize the memory of his initial chunk into smaller chunks. A speaker is constrained by the existence in his mind of clearly established patterns, here called schemata (Barlett, 1932). In narration, a speaker must choose which elements of his schema to include and which to leave out. Chafe believes that salience in some way governs or directs what a speaker verbalizes. He suggests that events are salient to the degree that they depart from the bland, routine, experience which makes up the greater part of people's lives.

In addition to choosing which elements of a schema to verbalize, Chafe believes that a speaker may actually need to chose the schema itself. He cites an example where a lecture is delivered twice, but each time with a slightly different schema. He believes that the speaker had stored the overall chunk in his longterm memory and has also stored in memory a number of smaller chunks. These smaller chunks provided the elements for the two different schemata he chose at different times. {While some of the chunks appeared in both schemas, there were differences, and the relationship among the chunks varied (see pp. 45-46). Chafe believes that the specific schema used was not stored in memory but was chosen as the speaker verbalized.

Framing

At some point during verbalization a speaker must arrive at chunks that are small enough to be expressed as sentences. This is the goal of the schematization process. (The initial grand chunk has too much content to be expressed sententially except by a summary.) A speaker must break down the initial grand chunk through a succession of schemata until he/she arrives at chunks which can be converted into sentences. Chafe believes that this stopping point in schematization is constrained by the existence of rames (as described by Fillmore, 1968). A schema provides a breakdown into smaller chunks. Chunks combine a spatial and temporal particularity and "... are holistic ideas of happenings at particular times and places." According to Chafe, a frame has a different breakdown than a chunk: it factors out from the event one or more individuals characterized by particularity in space but not in time. Thus, the idea of a particular person or object may take part in a variety of events at different times.

Below is an example of different frames describing the same event :

a. The older boy handed/gave/passed the younger boy a banana.
b. Two boys passed a banana.

Most of the elements are present in both versions, but their assignment - this time within frames rather than schemata - is quite different.

Categorization

A speaker must decide upon words for sentences. Some ideas of particular events and individuals are easier to categorize than others; this property is referred to as codability (some ideas being more codable than others). Brown and Lenneberg (1954), for instance, pointed out that some colors were more codable than others. Less codable colors are names with longer words or with phrases rather than single words, take longer to name, and show less agreement between subjects and less consistency for the same subject. Chafe found the same results when examining viewers' labels of two different objects (a banana and an unusual jungle gym), which were presented as part of a film clipping. When the banana was shown there was high codability (high agreement in terms of the label). When the playground object was shown many different modifiers and labels were applied.

Speakers have a way of coping with low codability; that is what modifiers are for. The jungle gym which was presented did not represent the prototypical gym with bars perpendicular to each other, instead, it contained irregular curved surfaces. One viewer thus referred to recognize not only a continuous scale of codability, but also a form of mental storage in which the uniqueness of particular objects is retained. Perception of an object or event does involve individuation, or codability would never be a problem.

Hesitations

Chafe cites hesitations in speech as evidence that speakers are making choices in terms of, for example, schematization, framing and categorizing, as they verbalize. He also suggests that an examination of the hesitations makes it possible to determine what kind of choice was being made.

Implications

In this, the last section, Chafe points out that diagrams which represent human memory are not appropriate if one agrees with everything he has presented above. He argues that schema, categories and frames are decided upon during verbalization and thus cannot be depicted in a diagram. He also argues that aspects which are salient to one person may not be salient to another. He proposes that knowledge may generally be stored in a way that is not propositional, and that it may consist of individuated events and objects, each with an associated analogic content, but without established connections in a propositional network until verbalization necessitates propositional decisions.

Charniak, E. A framed painting: The representation of a common sense knowledge fragment. Cognitive Science, 1977, 4, 355-394.

Charniak attempts to develop "common sense" knowledge for "mundane" painting (painting a wall or an object, not a picture). According to Charniak, in order to display depth of understanding for painting, one must know how to do the particular acts involved and the consequences of not following through with a particular act, as well as, of course, knowing what the particular acts involved in painting are. (For example, in painting, one must know to wash the brush when through or else the paint will dry (process of evaporation) and the brush will no longer be absorbant, rendering it useless for painting.)) Such a computer program would be able to understand stories about the act of painting and should be of use by programs interested in carrying out the act of painting.

The Fundamentals of the Representation

Charniak provides a partial definition of a frame which he conceives of as "a 'large' body of information expressed in computer-usable formalism about a single topic where the facts are richly interconnected and which, while typically consulted as a whole consists of basic units (fact) which are individually useful." (In addition, GOAL marks the typical goal state of the event being described, while EVENT marks a more detailed description of the activity itself.)

The computer program should be able to compare information provided in a story with information stored in the frames. Inferences could then be made about how far along an individual is in the act of painting or why something was done. Inferences are drawn by referencing the frame. The input sentence instantiates one or more lines of one or more frames. For example, the sentence "Jack washed the chair." instantiates the fact that the chair is not dirty.

In order to indicate how particular acts are accomplished, there is a method for each goal. "(Goal (some state of affairs) USE method-name.))" Rather than USE, Charniak suggests COMES-FROM, e.g., spotting COMES-FROM dripping and splashing; painting COMES-FROM the physical process of STICK (liquid on object).

In order to understand why certain acts are accomplished they must have a "reason".

"A 'reason' is a description of the events that will occur, or fail to occur, if the suggestion is carried out." The term LEADS-TO is preferred to "reason." For example, as mentioned above, it is necessary to wash the brush after painting or the paint will dry on it. This would be represented in the following manner :

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(NOT (paint on instrument)
    LEADS-TO: (Paint-dry)
 COMES-FROM: (wash-goal)
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The method used above to prevent drying would be washing the brush. It should be noted that the leads-to pointer does not indicate causation. It does indicate, however, where relevant causal information is found.

Another feature of the computer program is the use of intermediary rules which link up in chains. For example, in order to avoid dripping one must be careful not to put too much paint on the brush. One needs a rule, therefore, which would allow for the removal of excess liquid. It is necessary to specify excess as being greater than some amount and this can be done through an intermediary which helps define GREATER.

There are four basic types of frames: complex event, simple event, state and object frames. A simple event describes a single cause and effect relation. Complex frames are connected by time relations (not causal relations) e.g., first you do this, then that. Unlike simple frames they include a GOAL which describes the desired end state. In states, as the name implies, there is no activity involved. Two examples of states are "A implies B" and "A IFF B (if and only if)." Object frames give a physical description of painting, implements, etc.

There are also adjunct frames which provide additions to or modifications of other frames. An example would be "how to use a brush or roller in painting."

Through the use of these frames and connectives between frames, Charniak plans the development of a computer program capable of understanding stories about painting using what he calls a "context free grammar."

Frase, L. T. Maintenance and control in the acquisition of knowledge from written materials. In J. B. Carroll & R. O. Freedle (Eds.), Language comprehension and the acquisition of knowledge. Washington, D. C.: Winston, 1972.

Frase is concerned with the effects of test-like events and instructions on learning. More specifically, he is interested in studying the levels of assertions which readers are able to derive or verify from text. Frase cites the following example. Fundalas are outcasts. The outcasts are hill people. The hill people are farmers and the farmers are peaceloving. This could be synthesized as A → B → C → D → E. Frase suggests that four levels of assertions are presented here. Level 1 consists of assertions that are explicitly presented in the text such as A's are B's or B's are C's. Level 2 assertions go beyond the information given and require the processing of two text sentences, such as A's are C's. Untimately, level 4 is reached, in which all of the experimental sentences are combined to produce the assertion A's are E's. Frase suggests that the level of a question can be defined by the number of items that mediate the answer to that question. To respond A's are B's could require processing only one sentence, while the response A's are D's requires the processing of three sentences.

Adult subjects read passages and were asked to determine whether the sentences typed above were valid conclusions. They were also asked to write down whatever they could remember, including inferences. Occasionally, recognition tests, which included valid and invalid assertions and in which subjects responded yes/no to given assertions (such as all A's are B's or all B's are A's), followed the recall test. Reading time was subject controlled.

Free recall data indicate that assertions which required fewer sentences were more likely to occur. For instance, an assertion requiring one sentence was more likely to be produced than an assertion requiring two sentences, etc. In addition, there was a greater tendency to produce valid assertions (A's are B's) than backward or invalid assertions (B's are A's). Frase also found that subjects were able to supply sentences in the text, but provided few higher level assertions, perhaps because subjects had read a number of different passages prior to recall.

Frase also asked adult subjects to verify sentences of varying inferential complexity after reading the corresponding passages. He found that there was an increase in the amount of text recalled with an increase in inferential complexity, but inferentially complex (higher level) problems had little effect on the level of inferences which subjects generated during recall. Additional research seemed to indicate, however, that higher level learning outcomes (the production of inferentially complex statements) were contingent upon a minimal level of text recall. The number of inferences that subjects generated, however, even after being exposed to as many higher level assertions as text sentences, were still small. Results from the recognition and recall tests were similar.

Frase also compared passages which presented assertions in a Good order (A's are B's, B's are C's) or a Bad Order (B's are C's, A's are B's). After scores were adjusted for guessing, Frase found that the recognition scores on memory text was 33% for the Good Order and 34% for the Bad Order. For inferences, however, twice as many were generated with the Good Order than with the Bad Order (41% vs. 21%).

Frase also studied the effect of order on primary school children. The passages were kept in front of the subjects, though the recall period was under experimental control. Part of one story follows: He found a big thing. The big thing was green. The green thing was a box, etc. The order of the sentences within the story was varied and presented to second-, fourth-, fifth-, and sixth-grade city and suburban children. Errors were greater when the sentences were scrambled. An interaction between level of question and organization was also found for the suburban children only. Frase suggests that the higher level processing of city children was less sensitive to organizational factors. In addition, performance dropped 20% when two sentences, rather than one, had to be processed in order to answer a question. In general, the second-grade suburban children performed similarly to the fifth-grade city children. Prompting (e.g., pay careful attention to "small thing," "two bag," etc.,) erased these effects.

Matz and Rower (1971) compared low-SES black fourth-graders and high-SES white fourth-graders on their ability to comprehend passages of the A's are B's, B's are C's, C's are D's, and D's are E's form.

The passages were read, but in one condition the text accompanied the tape with successive sentences continuously being added, while in the other (pictorial) condition, parts of a picture, corresponding to the sentences in the text, were added to each other. Population, presentation mode, and level of question were significant factors. There was a significant interaction between population and presentation. The low-SES black children who had been given the pictorial presentation did about as well as the high-SES white children who had read the text.

These data indicate that errors for children, like adults, increased as more sentences were taken into account. It appears that even second graders are sensitive to the organizational properties of text. In addition, higher level processes (inferences) seem to be most affected by organizational factors, both for adults and children.

Frase, L. T. Purpose in reading. In J. T. Guthrie (Ed.), Cognition, curriculum and comprehension. Newark, De: International Reading Association, 1977.

Frase discusses studies that relate learning outcomes to the focus and form of reading activities. He believes that there are two components to goal-directed reading: (a) content, the environmental stimuli that may become the focus of attention, and (b) operations, activities that a reader brings to bear on those contents. Frase examines three conditions which may provide a focus for the reader's attention: experimenter-imposed focus, self-imposed focus, and focus arising from interaction between the text and the reader's goal.

Content focus

The first study (Frase & Kreitzberg, 1975) examined experimenter-imposed focus. The subjects were 138 undergraduates. They were instructed to learn certain sentences of a 588-word biographical passage. These sentences were identified either by the initial words in the sentence or by topic. A word direction would be to learn the information in the sentence which begins "French, Spanish, Latin ...", while a topical direction would be to learn the information dealing with the number of languages that Nathaniel Bowditch studied. The posttest question as "How many languages and dialects did Nathanial finally master?" Each direction identified just one sentence. It was assumed that word directions merely required word matching and, on that score, were more precise. Topical direction required additional transformations and might, therefore, be considered less precise; however, they required meaningful processing of sentences.

In addition, positive and negative forms of directions were used. An example of a positive direction would be: "Learn the information in all of the sentences..." An example of a negative direction would be: "Learn the information in all of the sentences *except* ...." There were, therefore, four experimental conditions: *topical-positive* directions, *topical-negative*, *word-positive* and *word-negative* directions. A control group simply learned the text. The directions and the text were simultaneously in view. Ten minutes of reading time was allotted. The posttest was administered after a one hour delay.

Results in terms of the information explicitly studied showed that only the word positive group responded significantly faster than the control group. (Mean proportion correct responses for these two groups were .67 and .50, respectively.) The recall for incidental learning showed that the word negative group was significantly lower than all other groups, which did not differ among each other. Frase suggests that specific words in the text provide occasion for certain operations. Positive directions cue the reader to engage in activities which have positive learning outcomes.

Frase also cites a study in which focus is self-imposed by having subjects verbalize or write out their questions as they learned a text.

In one study 48 H.S. students participated. They either asked questions or answered questions or studied. They were yoked so that if one asked, the other answered. Sessions were tape recorded. The Bowdith biographical passage was used with prompted recall. It was hypothesized that recall for question relevant content would be higher than recall for incidental content and that the questioners would encode more information because they were making decisions as to the relevance of the information. It was found that subjects in either the questioning or the answering condition did significantly better than controls. Responses to incidental learning did not differ from controls. The same results were found using 64 college students, all of whom either generated their own questions or served as controls and simply studied.

In another experiment (Frase & Silbiger, 1970) college students had to search for the name of a planet whose characteristics had been described. None of the planets described in the text fit the description. Subjects were not told that they would be tested. There were four conditions. In one condition each paragraph described one planet. For the other conditions, the attributes were described in other portions of the text: thus, in terms of the reader, they were not well organized.

There were three categories of planet names. Criterion names had to be entered briefly into memory while the reader searched for additional information about the planets throughout the text. Compared names were those in other sentences which allowed readers to reject irrelevant sentences. Irrelevant names could be disregarded immediately because sentences describing the planet were together.

Results for immediate and delayed posttesting were similar. Only the conditions in which a search was required were significant (criterion and compared). Mean proportion delayed recognition was .68, .58 and .34 for criterion, compared and irrelevant names, respectively. Memory for items, Frase suggests, is a function of whether or not the items were entered into the readers goal directed activities.

Operations

Frase also examines three kinds of operations that affect learning : semantic operations that a reader performs, sequential nature of the content and directions, and retrieval operations.

Frase studied semantic operations by examining how reading interfaces with previously learned meanings of words (Frase & Kammann, 1975; Frase, 1975). A subject would be given a list and would be asked to check off foods (a general category) or fruits (a specific category). It was found that recall was greater under the specific category condition than under the general category condition. Specificity of encoding, then, seemed to lead to greater recall; both the focus and form of attention are important factors in recall.

Other studies have indicated the importance of processing activities. Anderson and Hidde (1971) found that subjects remembered more if they rated the imagery of sentences rather than the pronounceability. McKenzie (1971) found that students who had seen inference quizzes over a period of weeks were better at drawing inferences than those who had seen factual quizzes.

Frase also studied the effect of the sequence of information contained in the directions as it compared to the sequence of information present in the text. The subjects were 96 undergraduates who were presented with a passage whose sentences were either randomly ordered, ordered by ships' names or ordered by attributes. Directions mentioned either names or attributes first. (Free recall data indicate mean errors for attribute first directions was 1.1 under the name organized passages, and 2.7 under the attribute organized passages. Mean number of confusions for the name first condition was 1.7 for the name organized passage, and 1.6 for the attribute organized passage.) There was a significant interaction between sequence of directions and text; subjects seemed to do better with name first passages when directions presented either attributes or names first.

In terms of review operations, Anderson and Biddle (1975) have indicated that posttests, especially those which repeat the text verbatim, facilitate recall. Frase suggests, however, studying the effects of stimulus control on memory by examining these controls in an encoding, rather than retrieval, context. He points to the fact that studies on review have long-term memory constraints.

Frederiksen, C. H. Representing logical and semantic structure of knowledge acquired from discourse. Cognitive Psychology, 1975, 7, 371-458.

A model of logical and semantic structures from which speakers and writers generate linguistic messages at the discourse level is presented. While linguistic structures were considered in developing the model, the semantic and logical networks are defined without reference to linguistic structures and, thus, may be used to represent knowledge structures from both linguistic and non-linguistic sources. Semantic structures are underlying structures from which texts are generated and representations of knowledge acquired from texts.

The model is defined without reference to linguistic structures and is capable of representing the informational structure of non-linguistic "messages" such as visual arrays and experienced events, as well as that coded in linguistic messages. The model represents semantic structures and logical structures. Semantic structures consist of propositions which are represented as networks of concepts connected by labelled binary relations which identify events or states. Logical structures consist of networks of propositions which are connected by various labelled logical, causal, and algebraic relations.

Chomsky places major emphasis upon syntax with the sentence as the unit of analysis. Generative semanticists McCawley (1968) and Lakoff (1971) suggest adoption of a system of grammar which starts with logical predicates and contains rules for mapping these propositions directly onto surface sentences. Many linguists criticized taking the sentence as the primary unit of analysis, and defining the grammaticality of a sentence without reference to the context. They point out that any linguistic theory which attempts to define grammaticality in isolation from context will be an inadequate model of speakers' competence.

The model presented here attends to (1) the conceptual context of an utterance: the presuppositions (beliefs and intentions) held by a speaker at the time of an utterance (Kartunnen 1968, 1971, 1974; Keenan 1971); (2) the extra-linguistic context: the time, place, and location of the speaker and hearer (Fillmore 1966, 1971; Leech 1969); and (3) the linguistic context: the context given by previous discourse within which a sentence is embedded (Halliday, 1970; Chafe, 1974).

In addition to considering semantic and logical structure, the model considers algebraic (and metric) properties of "noncase" resulting in a mechanism for representing comparative relations, relations of relative time and location, tense and aspect.

A set of concepts applied to the model must include every concept which is lexicalized in English, and the set of labelled relations must reflect every relation which could hold between concept pairs. Some concepts developed for the model are as follows :

Objects - have a location in space (+location).

Actions - occupy position or an interval of time, and involve change (+time) (+change).

(+feature) - means that the feature is a defining feature for a class of concepts.

(-feature) - means that the absence of the feature is a defining property of the class of concepts and features.

An event consists of an action or class of actions, and of a set of relationships. There are two types of relations: case relations and identifying relations. Case relations specify a causal system involving an action. Identifying relations distinguish an action or class of actions from other classes of actions.

Frederiksen, C. H. Semantic processing units in understanding text. In R. O. Freedle (Ed.), *Discourse processes*: *Advances in research and theory*. Vol. 1. *Discourse production and comprehension*. Norwood, N. J.: Ablex, 1977.

Knowledge is generally acquired from organized informational inputs with a high degree of structure and generally from linguistic messages or texts. A problem in cognitive theory is to determine the nature and structure of knowledge acquired from linguistic messages.

One way is to investigate the text, under the assumption that the text reflects the knowledge structure of the writer. The argument is that if semantic structure is manifest in language it must also represent an aspect of human memory structure. This approach is advanced by Frederiksen (1975a) and underlies current models of memory structure (Crothers, 1975; Kintsch, 1975; Norman and Rumlhart, 1975).

Units in Textual and Semantic Structures

The notion of unit (a term introduced by Halliday), accounts for segments of spoken or written text that consist of recurrently meaningful patterns and/or operate as components of meaningful patterns. (Examples in English grammar would be morpheme, word, clause, sentence, etc.) Attached to units, in the theory of grammar, is a scale of rank or hierarchy; each unit consists of one or more than one of the units immediately below it in the hierarchy. The structure is the nature of the meaningful patterns that comprise a unit. Class refers to a set of items of the same unit (i.e., at the same rank) that show similar possibilities of operation in the structure of the unit immediately above in the rank scale (Gregory, 1972, p.7). And the final category, system, refers to the limited set of choices available in determining the structure of a unit. Winograd (1972) presented systems in the form of hierarchical decision trees to account for the structure of classes of groups, clauses, and sentences in English.

A labeled network consists of a set of labeled nodes that is connected into a graph structure by means of labeled arcs or relations. A semantic network is a labeled network which consists of a set of concepts, the nodes in the network, and a set of semantic relations that connect pairs of nodes. Semantic networks were proposed by psychologists as models for representing information in human memory (Crothers, 1975; Frederiksen, 1975a; Norman and Rumelhart, 1975; Quillian, 1968) and by computer scientists as computer data structure in language understanding programs (e.g., Schank, 1973; Simmons, 1973; Winograd, 1972).

Frederiksen's (1975a) model of logical and semantic structures has a number of distinguishing characteristics. First, the model is a well defined system in that every relation is specified without reference to linguistic productions. Second, it consists of two network structures: (a) a semantic structure representing events or states which connect slots generally containing concepts; and (b) a logical structure consisting of logical, causal or algebraic relations. Third, the model considers in detail the algebraic (and metric) properties of "noncase" relations (i.e., classificatory, attributive, degree, temporal, locative, and quantifier) and defines certain relations having specified algebraic properties (transitivity, symmetry and reflexivity) which may be used to connect propositions containing these noncase relations. This results in a mechanism for representing comparative relations, and relations of relative time and location, tense and aspect. Fourth, the model contains a probabilistic element to account for the fact that speakers are often uncertain and hence imprecise. Finally, it distinguishes between "symbolic" and "nonsymbolic" objects and "cognitive" and "incognitive" actions. Six units occur in the semantic and logical networks: concepts, relational triples, event frames, propositions, relative systems, and dependency systems (Table 1, p. 61). Semantic units form a rank scale with a concept being the smallest and noninclusive unit, and the dependency system being the largest, most inclusive system. Examples of concepts are objects, actions, attributes of objects, attributes of actions, etc., while logical systems and causal systems are two examples of dependency systems.

Consider the following :

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43  (: Indiana Dunes)-- HASP  → (:mounds)

44  (: mounds) HASP   →  (:sand)

45  (:sand)--I. PAT ASPCT (HAB) → ('shift)--=MAN. EXT 1 ('slowly)

46  (:mounds)--EXT 1  → (great)
```

This computer printout can be interpreted in the following way :

line 43: the object Indiana Dunes has as a part mounds

line 44: the mounds are composed of sand

line 45: the sand is the inanimate patient of the processive action shift, the action being identified by a manner relation attaching the attribute slowly to the action shift..

Some of the concepts (lowest rank) exemplified above are: objects (mounds); processive actions (shift); resultive actions (develop); attribute of actions (slowly); etc. Examples of relational triples: processive case relations (sand →shift); resultive case relations (steel industry → develop); stative relations (mounds → great); manner relations (shift → slowly) etc.

An event frame is a unit that is composed of a set of relational triples which are connected to an action and identify the various participants in an action, its resulting effects, etc. Event frames cannot stand alone but involve a system of causes and effects. It does not represent a complete event, it does not specify time, spatial location etc., but is a component of an event proposition. Manner relations, stative, locative and temporal relations may also occur as constituents of event propositions. There are two kinds of event frames:

processive event frames, for example, (sand → shift) and resultive event frames, for example, {Department of Interior → submit → object (report)}.

A relative system consists of a pair of relative or metric proportions connected by an algebraic relation or function. It contains propositions as constituents. For example, Indiana Dunes, Indianapolis--D → near. In this example, an algebraic function (distance) connects two locative propositions.

The dependency system is the highest unit of rank and consists of logical, causal and conditional systems. What these systems have in common is that one proposition is made dependent on another either logically, conditionally or causally. "Conceptual dependency" is used by Schank to refer to any two concepts which are linked by a relation and thus rendered "conceptually dependent". Logical, causal, and conditional systems consist of pairs of propositions connected by logical, causal, or conditional relations respectively. An example of a causal system would be, (Congress caused Indiana Dunes Lakeshore.) (In actuality, Congress authorized the establishment of the Lakeshore to satisfy environmentalists and the nearby steel industry.)

Semantic Units in Memory Structures and Discourse Processing

There are two levels of processing in discourse comprehension that involve propositional data structures. The interpretive level involves those processes by which propositional knowledge is "recovered" from text. The inferential level involves the generation of new propositional knowledge from a network of propositions which is given - from prior discourse, from context, or from stored knowledge of the world. Inferences may also function to define higher-order semantic units. Thus, for example, two propositions in a text which are referentially connected may also be related in the two link structures inferentially, if one proposition may be derived from the other by inferential operations. References to text level structures in papers on discourse analysis frequently involve inferential units. (Crothers, 1975; Kintsch and Van Dijk, 1975).

Processing Units in Understanding and Recalling a Descriptive Text

The study presented here investigates semantic processing units in discourse comprehension and recall. The study was designed to establish that semantic units are important to discourse processing during recall; and that semantic processing units, including high-level inferential and referential units, are important to the processes involved in acquiring knowledge from text. Other aspects of discourse processing were also addressed.

Method: Texts were constructed from three descriptive and narrative "target" propositional structures describing three areas in the Midwest. In addition, the three target structures were connected by one of two linking structures: either a similarity link which consists mostly of superordinate propositions that describe similarities among the three areas and events involving the three areas. A filler structure was also constructed that describes a fourth geographical area (target paragraphs describe three geographical areas) and controls for repetition of information. The subjects were 129 undergraduates.

Oral presentation of text was followed by free recall. The number of words in the text, reading time, and the period allowed for recall were controlled.

Passages were taped to insure uniformity, and average reading time was five minutes. Sufficient time was allowed for recall. Recall protocols were compared to the computer printouts of propositions.

Results: There was considerable within-cell variability indicating that people differ substantially in the amount and kind of information they are able to recall from text. There was an order main effect; more target information was recalled when target information was presented first. This seems to reflect the tendency to acquire more semantic information from the earlier parts of text. Presenting causative linking information, before or after the target information, resulted in more target information being acquired.

The mean number of target items recalled, pooled from both target first and target last conditions, for causative and similarity linking structures, and filler structures, was 77, 78, 69.09 and 64.68, respectively. There was a significant difference between causative and filler structures. According to Frederiksen, the fact that presenting the causative information last improved recall demonstrates a retrieval effect. Linking information that connects target propositions referentially and inferentially increases the likelihood that the target propositions will be retrieved and recalled. Frederiksen further points out that this provides evidence that high-level semantic processing units are used in retrieving previously stored semantic information.

The causative linking structure has a greater effect when presented before the target information than afterwards. Causative linking thus effects acquisition as well as retrieval. Frederiksen points out that the results obtained are consistent with the interpretation that high-level inferential semantic processing units occur in processing discourse both during comprehension and recall of a text. When similarity information was presented last, it facilitated recall more than did the causative information, but when it was presented first, it had a small negative effect.

In explaining these results, Frederiksen points out that the larger retrieval effects associated with the similarity passage may be due to the fact that the similarity passage does not introduce any new information that cannot be derived from the target passages by means of low-level inferences: it simply summarizes the similarities among the three target descriptions. On the other hand, the causative passage introduces new events, as well as causative links between the new events and the events and descriptive information in the targets. More similarity information was acquired from the similarity passage than from the passage that included both similarity and causative information. The data as a whole indicate that the nature of the linking propositions and the order in which the propositions are staged are both important factors in determining what higher-order processing units occur and when they occur - during comprehension, during recall, or both.

Frederiksen studied the inferential operations by which propositions presented early in a test are employed in processing other related propositions occurring later in the text. He identified three categories of target propositions: redundant propositions; embedded propositions which may be inserted into slots in frame propositions; and subordinate propositions which are derivable from superordinate propositions in the linking structure by replacing one (or more) conceptual classes in the superordinate proposition with subordinate conceptual classes.

Associated with each category of target proposition, there is a specific type of inferential processing operation. When a redundant proposition is encountered in semantically interpreting a target passage it may be recognized as old information and eliminated from the memory structure which is built up for the target passage. This is called selective processing. The second type of inferential processing, slot-filling, involves using previously acquired propositions as frames into which target propositions are inserted. The general prediction is that propositions that were classified as embedded, because they can be inserted into slots in propositions in the linking structure, will be recalled with higher probability when they were preceded by frame propositions than when they were preceded by the filler. There is weaker evidence for slot-filling than for selective processing as an inferential text processing operation. Regarding superordinate inferences, the prediction is that the probability of recall of a target proposition will increase when it has been preceded by a proposition superordinate to it. There is strong evidence for this.

The data also seem to indicate that items of semantic information are recalled in mutually dependent clusters of items. In other words, certain propositions seem to be recalled together. Clusters correspond to units of semantic information such as concepts, states, events, or other higher-order units. Understanding a text involves analyzing it into highly structured semantic units. These semantic processing units occur at different levels, from units as small as elementary concepts to units that incorporate large portions of a text's content.

Thus, Frederiksen establishes that texts contain ranked units of information which are processed as units, both during knowledge acquisition and during recall. Future research possibilities are discussed.

Freedle, R., Naus, M., & Schwartz, L. Prose processing from a psychosocial perspective. In R. O. Freedle, (Ed.), Discourse processes: Advances in research and theory. Vol. 1. Discourse production and comprehension. Norwood, N.J.: Ablex, 1977.

The authors hypothesize that social information about author and intended listener affect how a subject in a laboratory setting will process, store and retrieve the prose information when he is to recall the passage. Social information, then, can significantly affect the information-processing steps of a subject.

The psychosocial processing model affects conditions under which lexical simplification (deconfabulation) will occur, and also predicts a special set of circumstances under which the lexical entries of the original passage is either left intact (called same-order confabulation) or is made more complex (higher order lexical confabulation). An example of higher-order lexical confabulation would be the substitution of "TV cartoons and special shows..." for "Public entertainment media for children..." The experimental conditions were: (1) a child story retold to an adult, (2) a child story retold to a child, (3) an adult story retold to an adult, (4) an adult story retold to a child.

Method: Adult college students served in all four conditions. The hypotheses from the psychosocial paradigm is as follows: When the actual listener of the subject's retelling matches the age of the author's intended listener, minimal changes in the structural complexity of lexicon and syntax can be expected. A socially responsible speaker is one who is aware of his obligation to create a discourse that honors the social contract which underlies an acceptable communicative act (Clark and Haviland, this volume). If the original passage is retold to other than the intended audience one would expect that the passage will be altered in the retelling to be socially well formed. The age of the listener was the psychosocial factor studied here.

All of the subject's stories were collected and dispersed randomly throughout the whole collection and were judged by one individual as to whether they were adult or child stories. This procedure was a more stringent method of scoring than would be obtained by judging each subject's protocols individually.

Results: When the experimental instructions requested that the subjects supply an adult version of a myth passage (originally intended for an adult) the scorer identified the end product as an adult story in 23 out of 24 cases. When the instruction requested a child version for the same passage, the scorer identified the protocol as a child story in 21 out of 24 cases. The subject's telling of a TV story (originally intended for children) was recognized as a child story by the scorer in 22 out of the 24 cases. When a verion of this story was intended for an adult it was recognized as such in 24 out of 24 cases. Thus, the subjects transformed the passage to adjust to the age of the projected listener.

A second experiment was conducted in which additional adult subjects were merely instructed to retell the stories to the experimenter. In this case, the adults spontaneously transformed the child TV story into a version more suitable to an adult.

The psychosocial model suggests the following hypotheses: 1) When the original passage was written for an adult, but is to be retold to a child, one would expect the vocabulary to be simplified and one would also expect some information to be deleted only if it is judged beyond the capacity of the actual listener. 2) When the original passage is intended for a child but is to be retold to an adult, one would expect the vocabulary to be made more complex and for information to be added so as to make the content more appropriate and "interesting" to the adult listener. In general the results presented here fit a psychosocial model: the speaker adjusts a story to account for the age of the listener.

Freedle also discusses at which point the adjustment is made by the speaker - while processing the story or during retelling. These data were obtained by interviewing a number of subjects.

The adult protocols were also examined in terms of the degree and type of psychosocial transformations which were peforemd. The authors found that adults tended to formalize vocabulary and to introduce higher-order confabulation when telling a child story to an adult. When telling an adult story to a child, subjects tended to define terms or omit them and use the definition or a synonym in their place. Subjects also tended to employ a formal mode for adult listeners, while for child listeners they tended to select a narrative mode and use "sing-song" intonation.

When addressing an adult, the term myth - an adult term - was retained 17 out of 24 times, but only 2 out of 24 times when the intended listener was a four year old child. In the other cases (22 out of 24) the adults simplified the myth concept.

The authors found that when the adult subjects were presented with a passage originally intended for an adult, they responded significantly differently to the two age groups (adult vs. child). This supports the psychosocial model.

When the adult subjects were presented with a passage originally intended for a child, they used higher-order confabulations when addressing adults as opposed to children (7 versus 1). Again, the subjects responded in a significantly different fashion to the two age groups.

The authors therefore believe that prose comprehension models must include explicit decisions which reveal how the subject transforms the "raw" information in a text so as to honor the social norms of a communicative act.

Gentner, D. On relational meaning: The acquisition of verb meaning. (Tech. Report No. 78). Urbana, Ill.: Center for the Study of Reading, University of Illinois, March 1977.

Verb meaning acquisition, when compared to noun meaning acquisition, shows evidence that: (1) verb meanings are relatively slow to be acquired; (2) the acquisition of verb meaning is componential; and (3) verbs are used by children and adults with greater breadth of application than simple nouns. Simple nouns refer to real world entities while verbs convey the relationships among entities. It has been shown that the acquisition of verbs lags behind the acquisition of nouns (Ervin-Tripp, 1971; Goldin-Meadow, Seligman, and Gelman, 1976).

Representation of verb meaning: the systems are componential in that verb meanings are represented in terms of meaning elements which are smaller or more primitive than words, and propositional in that semantic relationships are explicitly represented. {Prepositional network notation is used here. Elements of the representations are predicates, which stand for relational concepts (e.g., cause); and labelled pointers, which identify the entities to be related (e.g., →)}. Most English verbs are represented by a set of several subpredicates with a number of interrelationships. Below is part of an example provided by Gentner.

GAVE

CAUSE
event result
DO CHANGE
from to

possessor possessor

Some components of verbs can be further analyzed, and the representation of verbs it not exhaustive. Subpredicates of a verb express almost inevitable inferences that are made during the comprehension of a sentence containing the verb. The components of simple nouns are highly inter-related as compared to verbs. Noun meanings are constrained by the nature of the physical world, while verbs express relational meanings which depend upon abstract concepts and are relatively unconstrained by the physical world. (For example, understanding the verb give involves an understanding of cause and possession.) This difference in abstractness is reflected in children's slowness in verb meaning acquisition as compared to the acquisition of noun meanings.

One theory of word meaning acquisition is the Semantic Feature Theory posited by Clark, 1973. According to this theory, words with few components should be acquired prior to words with many components, errors being indicative of incomplete semantic representations. The information stored in early word meaning will be predominantly perceptual. Nelson (1974) presents an alternate view of word meaning acquisition which places emphasis upon functional information: children attend to the dynamic and functionally relevant aspects of situations (and this predominates over perceptual information). Extraneous relations drop out later, and the internal structure of concepts is at first holistic, not analytical.

The author examined the acquisition of the following sets of verbs: (1) give, take; (2) pay, trade; and (3) spend, buy, and sell. They represent three groups of complexity: components of (1) are do, cause, change and possess; for (2) the components are those listed above as well as social obligation (oblig) to transfer money, etc.; and (3) consists of the components of (1) and (2). It was predicted that verbs would be acquired in order of complexity and that there would be incomplete representations of complex verbs.

Children were given toys, a doll, and money, and were asked to act out. For example, "Make Ernie buy a car from Bert." Criterion for acquisition was 75% correct. There were 5 age groups ranging from 3½ to 8½ years old with 14 children per group.

Gentner found that Group 1, Group 2, and Group 3 verbs were acquired by 3½, 5½ and 8½ years of age, respectively. The results support the notion of componential acquisition. The children acquired components such as do, cause, change and possession; and representations of complex verbs were based on these components. (For example, buy was acted out like take by the younger subjects.) Clark's theory states that form and not use are the critical attributes which a young child uses in early word meaning, while Nelson believes that use and form is prominent. Two experiments were designed to compare form, motion, and use in which novel objects were constructed to separate these variables. In one experiment, form and use were opposed; and in the other, form and motion.

In Experiment 1 children learned the names "jiggy" and "zimbo" for 2 objects differing from one another in both form and use. The child was then asked to name a hybrid which was identical to the jiggy in form and to the zimbo in use. If meaning is based on use, the name zimbo should be applied to the object; if form is the basis for word meanings, then the hybrid should be called a jiggy. 53 subjects participated, aged 3 to adulthood. The children encountered each object separately in a naturalistic situation. After it was ascertained that the children remembered the first object they had been presented with, they were introduced to the hybrid. The author found that young children, aged 2½ to 4½, apply words on the basis of static perceptual attributes and not on the basis of use.

In Experiment 2, form and motion were opposed with the same basic design applied this time to both nouns and verbs. 8 subjects in each of the following age groups participated: 3 to 4 years; 4 to 5; 5 to 6; and adult. Two novel objects were each made to move in a particular motion pattern by means of motors. The objects were similar in size and color but different in their shape and pattern of motion. The child either learned the name of the object (noun condition) or the name of the action (verb condition). The pairing of the object with a name was counterbalanced.

The test object was a hybrid with the shape of one, and the motion pattern of the other. The child was retrained and was shown an alternative test object. This provided two noun responses and two verb responses per child. The proportion of motion responses is higher at every age for verbs than for nouns. Even at age three children appear to differentiate to some extent between verbs and nouns. The younger children respond predominantly on the basis of form, though less so for verbs than nouns. Motion responses appear to increase with age, but only in adults is there any strong tendency toward motion responses, even for verbs. Children more readily formed meaning representations based on form than representation based on motion. The results of both experiments indicate a predominance of form over use (Experiment 1) and a predominance of form over motion (Experiment 2).

A third experiment was designed to compare motion vs. use. Subjects were asked to label various events. The experimenters beat or shook mixable and nonmixable substances. For example, salt and water are considered mixable because mising results in greater uniformity, while cream is not mixable since its homogeneity remains unchanged. There were six combinations of the two substances with the three actions. The subjects were 5-7 year olds, 7-9 year olds, and adults with 8 subjects per group.

Gentner found that for the verb mix, an understanding of action meaning preceded an understanding of function meaning. All age groups distinguished appropriate from inappropriate changes of state in their uses of mix. Older children and adults did make this distinction, applying mix more often to salt and water mixtures than cream. Younger children's action-meaning of stir was well specified yet it was the one most frequently over-extended. Gentner also points out that children choose to extend words whose meanings they know well.

Gentner points out that common verbs are broadly used in adult speech. Give, for instance, is used to convey change of possession, but we also say give a headaches, a college-education, and a good talking to, etc. Greater extendibility of verbs is probably a factor in the long time course of verb acquisition. A small number of verbs convey a large number of messages.

Semantically simple verbs are learned before complex ones. Children's initial word meanings are based primarily on perceptual information, and this may contribute to the slowness with which verb meanings are learned. Especially in the case of verbs, children, and to a lesser extent adults, extend words to situations that only partially match their stored representations.

The acquisition of verbs and nouns differs. First, verb acquisition is a slower process: verbs enter into the child's speaking vocabulary later, and the rate of vocabulary increase in the first few years is lower.

The meanings of many common verbs are not acquired until the child is eight or older. Second, the acquisition of verb meaning follows a more obvious pattern of accretion of components of meaning than does the acquisition of simple noun meaning. Finally, verbs are more broadly used by children and adults than nouns.

Haviland, S. E., & Clarke, H. What's New? Acquiring new information as a process in comprehension. Journal of Verbal Learning and Verbal Behavior, 1974, 13, 512-521.

Sentences contain both old and new information. The listener's aim, in comprehending a sentence, is to extract the new information and integrate it with the old information already in memory. The speaker uses syntax to identify what his audience already knows, called the Given information, and what his audience does not already know, called the New information. For example, "The jokes Horace tells are awful" Given: Horace tells jokes. New: Those jokes are awful. The above sentence presupposes the first and asserts the second. A variety of syntactic devices can be used for marking the given and the New (Halliday, 1967). These include: restrictive clauses, (that Horace tells) in "The jokes Horace tells are awful"; the adverbial too, in "Elizabeth tells awful jokes too"; the cleft construction where New information is introduced by it is, as in "It was Einstein who searched in vain for the unified field"; and use of the definite article the, to presuppose existence as in, "The morning star is the evening star."

The listener's strategy is to identify the syntactically marked Given and New information, locate (or construct) an antecedent in memory for the Given information, and then integrate the New information into memory at that point. If the listener does not have an appropriate antecedent in memory for the Given information, upon which he can attach the New information, comprehension should be slow.

Experiment 1 tested the above prediction. Pairs of target and context sentences were presented, in which the target sentences always contained a definite noun phrase (e.g., The alligator was his favorite present). Half the time the context sentence preceding the target explicitly mentioned the existence of the referrent of the noun phrase (e.g., Ed was given an alligator for his birthday. The alligator was his favorite present); and half the time it did not (e.g., Ed was given lots of things for his birthday. The alligator was his favorite present). According to the Give-New strategy, the comprehension time of the target sentences should be faster when the preceding context sentence was explicitly stated (direct antecedent condition), than when it was not (indirect antecedent condition).

Method: A total of 68 context-target pairs were used, 34 direct and 34 indirect antecedent pairs. An example of a direct antecedent pair: We got some beer out of the trunk. The beer was warm. An example of an indirect antecedent pair: We checked the picnic supplies. The beer was warm.

Context and target sentences were presented sequentially with response time measured by pressing a button. There were 57 trials (23 of which were practice and 34 test). Subjects were told to read and pay attention to the first sentence in each pair since it would be related to the second, and that it was the second sentence which the experimenters were interested in. Instructions to press the button after "comprehension" were deliberately vague. The subjects were 16 Stanford University students.

Results: Analysis of variance showed that comprehension time for target sentences was significantly faster in the direct antecedent pairs ($\bar{X}$ = 835msec.)

than in the indirect antecedent pairs ($\bar{X}$ = 1016 msec.). There were no reliable differences between the two lists, nor were there any interactions.

In the above procedure, the direct antecedent pairs contained the repetition of a noun, while the idirect pairs did not. Results, then, could possibly be attributed to the facilitating effect of repetition. Experiment 3, in which both pairs involved repetition, was therefore performed.

Nouns mentioned a second time are usually definitized (e.g., "an alligator" would become "the alligator" when repeated. An exception to this rule is exemplified by the following: Ed wanted an alligator for his birthday. In most sentences the phrase "an alligator" posits the existence of the beast while in the above phrase it does not. The fact that Ed wants one does not mean that the speaker had a particular one in mind. Therefore, in the sentence pair "Ed wanted an alligator for his birthday. The alligator was his favorite present." the target sentence has nothing for the alligator to match up to: there is no antecedent for the alligator in memory. This indirect pair should take a relatively long time to comprehend because an extra inferential step is required (that Ed has actually been given an alligator). According to Haviland and Clark, the difference between the direct and indirect antecedent pairs in Experiment 1 should remain if the results are attributable to the Goven-New strategy, rather than to word repetition.

Method: The method was similar to that used in Experiment 1. Indirect antecedent pairs were designed along the lines of the above sentence; the critical noun was repeated but did not posit the existence of the noun. Example of an indirect antecedent pair: Andrew was especially fond of beer.

The beer was warm. The direct antecedent pairs remained the same. Ten college students participated.

Results: Comprehension time for target sentences was significantly faster for the direct antecedent pair ($\bar{X}$ = 1031msec.) than for the indirect antecedent pair ($\bar{X}$ = 1168 msec.). There were no reliable differences between the two lists of sentences, nor were there any interactions. The results seem to indicate that mere repetition of the critical noun was not enough to account for the results of Experiment 1.

Experiment 3 examined the model using the type of presuppositions required by adverbs such as still, either, again, and too, as in "Vivian still knows her Ovid."; "Stephen can't dance the rhumba either."; and "Lance is out hunting mushrooms again." The effect of negation on the Given-New strategy was also tested.

Method: There were four types of sentence pairs. (1) Direct antecedent pairs with exact repetition of the critical word: Fred was right about the new rules. He was right about the old ones too. (2) Direct antecedent pairs using synonyms: Fred was correct about the new rules. He was right about the old ones too. (3) Negative antecedent pairs: Last Christmas Eugene couldn't stay sober. This Christmas he got very drunk again. (4) Indirect antecedent pairs: Last Christmas Eugene went to a lot of parties. This Christmas he got very drunk again. The adverbs still, either, again, and too were represented equally in the 144 pairs. The subjects were 27 adults.

Results: Target sentences were comprehended fastest in the direct antecedent condition ($\bar{X}$ = 1023msec.) and were comprehended about equally slowly in the indirect antecedent ($\bar{X}$ = 1097msec.) and negative antecedent ($\bar{X}$ 2 1088) conditions. This is highly reliable. The interaction between the antecedent conditions and the adverbs was not reliable. Differences among the four adverbs were only marginally reliable, and could be attributable to slight differences in average sentence length. The results also failed to support an explanation of these differences due to simple word repetition (as tested in Experiment 2).

Discussion: If the reader cannot find a matching antecedent on which to attach New information he must either build some sort of bridging structure, treat all information in the sentence as New and begin construction of a new separate structure, or attempt to recompute what is Given and New in the sentence. Consistent with predictions, Experiment 1 showed that the comprehension of a sentence containing a definite noun phrase (e.g., the beer) took less time when the context sentence had explicitly posited the existence of some beer, than when it had not. Experiments 2 and 3 showed that the results were not merely due to the repetition of nouns. Experiment 3 demonstrated the same phenomenon for different kinds of presuppositions associated with adverbs still, either, again, and too. When the target sentence had Given information which required a match with its negative (as in "not sober" and "drunk"), the target still took longer to comprehend because an inference was required.

Hurtig, R. Toward a functional theory of discourse. In R. O. Freedle (Ed.), Discourse processes: Advances in research and theory. Vol. 1. Discourse production and comprehension. Norwood, N. J.: Ablex, 1977.

Hurtig examines the extent to which conceptual categories of transformational grammar theory are useful in the construction of a theory of discourse. He considers discourse as a string of successive sentences. Discourse can be monologue, dialogue, or multiperson interchanges, and has a topical or logical structure which links the successive utterances. The theory of discourse must account for these links.

A general theory of discourse consistent with transformational grammar is required to deal with the possibility that a similar structure can underlie either a sentence or a discourse. If a discourse and a complex sentence can be derived from each other, then it should be the case that the semantic component of a transformational grammar could assign a semantic reading to a discourse.

A unit of discourse is not clearly definable. The linguistic grammar of discourse operates on the premise that given a discourse it can provide the correct interpretation for that discourse.

Bransford and Franks (1973) found that regardless of the nature of the learning sets, compound sentences were (falsely) recognized when they themselves were not in the learning set but their constituent simple predicates were. Likewise, simple predicates were recognized even though they only occurred as constituents of compound sentences in the learning set. According to the authors, this suggests that in the encoding of sentences, predicates and propositions rather the surface linguistic form of the constituent sentences.

Towards an interactionist theory of linguistic behavior

Slamecka (1964) demonstrated the effect of contextual constraints on the acquisition and recall of sentences. Frase (1968, 1969) demonstrated an effect of text organization on acquisition and subsequent recall. He concluded that verbal problem-solving behaviors are subject to constraints imposed by the temporal arrangement of syllogistic terms. Freedle and Grae (1965) found that recall of sentence pairs presented under speeded speech conditions (accelerated 2.5 times normal speed) could be affected by the meaningfulness of successive sentence pairings.

Studies by Anderson and Bower, 1973; Crothers, 1972; Frederiksen, 1972; Kintsch, 1972; and Tulving, 1972 generally support the notion that the text or discourse is the unit of organization in memory.

Bransford and Franks (1973) and Johnson, Bransford and Solomon (1973) demonstrated that recognition of novel sentences by subjects is not determined on the basis of the surfact structure of sentences in acquisition materials, but rather on their propositional form or the implications that can be drawn from the sentence being read (within a single sentence boundary) or from a prior sentence (across a sentence boundary.) In the former, the target was three words back and in the latter, six words back.

Method: Passages were read aloud and silently by subjects. Probes were encounted after turning the page and referred to a probe and target at the end of the previous page. Subjects were told a comprehension test would follow.

The subjects were third- and fourth-graders, divided into groups of skilled and less skilled readers on the basis of their scores on the Metropolitan Reading Test. Skilled and less-skilled readers were closely matched for mean IQ.

Results: Skilled readers recalled significantly more targets than less-skilled readers (76% vs. 65%); recall during oral reading was better than silent reading (74% vs. 70%); and targets with three intervening words were recalled better than those with six when a sentence boundary intervened (79% vs. 56%). The sentence boundary effect as reflected by recall across and within a boundary does not seem to differentially effect high- from low-skill readers. There is some indication, however, that the number of words back which the subject is asked to recall in order to supply the target does differentially effect good and poor readers (Perfetti, Bell & Goldman, 1976). Skilled readers performed better when asked to paraphrase, as well as during the verbatim measure. Perfetti and Lesgold suggest that differences in recall among good and poor readers stem from differences in the encoding of sentences during reading.

A second and similar experiment was performed with the difference being that this was a listening task.

Method: In this experiment the number of intervening words was greater, 6-8 for a near probe and 13-15 for a far probe; and some test sentences contained two clauses, a subordinate (S) and a main clause (M), the order of which was experimentally varied. Examples of materials:

Type M,S. : It had been a beautiful day for rowing. Nick began to have trouble when a thick fog came in from the sea. (Probate)

Type S,M : It had been a beautiful day for rowing. When a thick fog came in from the sea, Nick began to have trouble. (Probe)

Third- and fifth-graders participated and were placed in reading groups on the basis of achievement test scores and were matched on IQ.

Results: Although this was a listening task, skilled readers were higher in probe memory performance than less-skilled readers. Group differences were observed for near probes (about 7 words back) and far probes (about 14 words back), and for both types of two-clause sentences (M,S) and (S,M). According to Perfetti and Lesgold, these results suggest that the processing demands that accompany clause integration may be an important source of individual differences.

Good and poor readers were equally affected by sentence boundaries. It has been suggested (Jarvella, 1971) that sentences are removed from active, short-term memory upon reaching the sentence boundary, and this appears to be true for both skilled and less-skilled readers. During an earlier study, subjects were asked to recall a digit which had followed a probe. From one to nine digits intervened before the probe test appeared. No significant differences were found between groups (Perfetti & Goldman, 1970).

Kernan, K. T. Semantic and expressive elaboration in children's narratives. In S. Ervin-Trip & C. Mitchell-Kernan (Eds.), Child Discourse. New York: Academic Press, 1977.

Kernan addresses himself to semantic and expressive elaboration in narratives. Semantic elaboration refers to "elements of the narratives - and structural relationships between clauses in the narratives - that do not serve to relate the temporally sequenced events that constitute the narrative proper, but serve to provide information that is necessary to the desired semantic interpretation of the narrative, or serve to organize the semantic interpretation of the narrative, or serve to organize the semantic elements of the narrative in a particular way." Expressive elaboration refers to "elements of the narratives that serve to make the narratives interesting to, and appreciated by, the audience."

The data discussed are narratives of personal experience as told by black American girls residing in a lower economic class, black, urban, West Coast community. These narratives were told to black female interviewers whom the girls knew well. There were three groups: second and third graders (7-8 years old); fifth and sixth graders (10-11 years old); and eighth and ninth graders (13-14 years old). Narratives were mostly responses to prompting questions by the interviewer. Interviewers attempted to ask questions based upon ongoing verbal communication, but questions similar to those of Labov, such as "Were you ever in a fight?" or "Were you ever really frightened?", were also used.

Kernan considers narrative, as do Labov and Waletzky (1967), as a recapitulation of past events. Labov (1972b) divided the narrative into six sections and they are, in order: (1) abstract, (2) orientation, (3) complicating action; (4) evaluation, (5) result or resolution, and (6) coda. Most narratives do not contain all six elements.

"Abstracts" are clauses which occur at the beginning and summarize the story or the result of the story, e.g., "We almost drowned in L.A." Narratives may also begin with an "introducer", a stylized way of indicating that the following will be a narrative, e.g., "Well see, this what happen." Abstracts and introducers serve the structural function of marking the exchange as a narrative. Abstracts also serve a semantic function by presenting a general statement of the narrative. The youngest groups used an abstract or an introducer only once; the middle group five times; the oldest group four times. This is complicated by the fact that narratives were initiated either spontaneously, by a question.

The second section, "orientation," provides some information as to time, place, persons, and their activity or situation. Orientation clauses may provide background knowledge which characters may or may not have, mood of characters, or other information necessary for story understanding. The sentence, "I remember one time when I was 6 years old," serves as both an introducer and an orientation clause. The function of orientation clauses is semantic. All children provided some sort of background information. The mean percentage of orientation clauses compared to the total number of clauses for each group were 11%, 27% and 22% for the youngest, middle, and oldest group, respectively. Of these, 3%, 20% and 17% were denoted to background information and conditions by the youngest, middle, and oldest group. Percentages of orientation clauses denoted to background information nefessary to understand the subsequent action were 27%, 69%, 71% for the youngest to oldest group. Older children provide background information such as mood and motivation, while younger children identify such specifics as time, place, and characters. While children in the younger group identified characters by either name or status, children in the middle and older group generally used both.

The complicating action and result sections constitute the narrative proper; they relate the events and the sequence in which they occurred. Their function is semantic. Narratives of median length were chosen for analyses, therefore, the percentage of clauses devoted to this section are a function of the percentage of clauses devoted to other sections. Kernan does not discuss the quantity of these clauses.

Evaluation clauses, Labov suggests, make the narrative appreciated, and considered by the audience as worth telling; they may occur at any point in the narrative. Clauses are expressive (rather than semantic) in function and individuals use a variety of narrative techniques.

"Codas" constitute the final section of a narrative (Labov & Waletsky) and serve a structural function in that they signal the end of the narrative, e.g., "I just sat there playing with my compass, that's all." The end statement may also be a moral or main point of the narrative, e.g., "I felt sorry. I shouldn't did that in the first place." This section is generally absent in narratives. Narrative techniques such as exact repetition, paraphrase with no information added, restatement of a semantic notion with added detail, etc., are also used. Repetitions were generally rare and basically served to resume the narrative following a digression, elaboration or audience interruption. Older children were more likely to use the above techniques for elaborating upon background information.

Kernan points out that clauses connected by and, then, and and then indicate a relationship with the preceding clause that is either independent, temporal, or both. Clauses that are introduced by so, so then, and and so then, depend on the existence of the preceding clause or clauses for their interpretation. The use of connectives and, then, and and then decreases with age, while the use of so, then, and and so then increases.

Kernan also discusses the use of expressive clauses indicating the narrator's attitude such as, "I was so scared." or "I said, I'm getting out of here." The use of expressive clauses increased with age; the percentages were 19%, 26%, and 31% for youngest, middle and oldest group, respectively. Emphasis is one category of expressive elements and may be exemplified by the following sentence: "I got real mad." The percentage of all clauses using stress were 7%, 8% and 15% for the youngest, middle and oldest group.

Thus, children differing in age, vary in their narrations with younger children focusing upon specifics while older children are much more likely to elaborate.

Kintsch, W., Kozminsky, E., Streby, W.J., McKoon, G., & Keenan, J.M. Comprehension and recall of text as a function of content variables. Journal of Verbal Learning and Verbal Behavior, 1975, 14, 196-214.

The present paper explores some aspects of memory for text, using a theory for the representation of meaning proposed by Kintsch (1974). The theory assumes that basic units of meaning are propositions. Propositions are n-tuples of word concepts, one of which serves as a predicator and the remaining ones as arguments. A predicator specifies a relationship among the arguments of a proposition. For example, consider the following proposition. Love, experiencer: Greek, object: Art. The two arguments are "Greek" and "Art" while the predicator is "Love". In English the proposition could be the sentence "The Greeks loved art." Arguments are concepts rather than words. Word concepts are stored in semantic memory which indicates combinations of word concepts that form acceptable propositions, and are defined by the propositions in which they are used. Text bases are connected, ordered lists of propositions, which represent the meaning of a text.

Kintsch and Keenan (1973), and Kintsch (1974) showed that reading time increases monotonically with the number of propositions in a text base, even if the length of the corresponding text is controlled. The present study replicates previous experiments and examines in addition the number of word concepts. Two types of passages are examined which differ in the number of word concepts used. For example, a text base consisting of eight propositions may employ only three different word concepts which are used repeatedly as arguments of different propositions, or an eight-proposition text base may use several different word concepts as arguments, with fewer repetitions. The former type of text keeps mentioning the same few things, while the latter employs many different ones. Which is harder to read and remember?

Haviland and Clark (1974) found that old information in a sentence can be processed more rapidly than new information. This seems to indicate that texts with many repetitions of the same arguments should require less time to comprehend than texts with many new arguments.

In Experiment 1, the texts constructed controlled for the number of propositions in the text base, but varied the number of different word concepts used as arguments of the propositions. Short and long text bases were used.

Method: Thirty-five college students participated. The materials consisted of twelve paragraphs on classical history adapted from a child's textbook. The main experimental variable was the number of different arguments (few vs. many). Length of text base (short or long) was a second factor. For each type of paragraph the number of words were kept relatively constant.

The theory for the representation of meaning defines an order relationship among the propositions in a text base: a proposition is said to be subordinated to another if it contains an argument that also appears in the first proposition. The theory is incomplete in that it has no way of generating the original set of propositions or its theme, for which we rely upon intuition. With few-arguments, the network is very tight: propositions tend to be related to each other all over the list. With many-arguments, on the other hand, each proposition is usually related only to those propositions immediately following it.

Procedure: Paragraphs were projected on a screen. After the subjects read the paragraph at his own rate, he pressed a response key which removed the slide, whereupon the subject wrote whatever he could remember. Recall did not have to be verbatim. The recall period was as long as the subject required, and the order of experimental slides was random. Only recall for complete propositions was scored. The two experimenters scored with an agreement of 95%. Errors were not counted more than once within a proposition.

Results: Reading times were longer for texts based upon propositions containing many-different-arguments than texts with few-different arguments, even though the texts were equated in regard to the number of words and the number of propositions in the underlying text base. The interaction was marginally significant: the difference in reading time that was observed between the paragraphs with few-and-many-different-arguments was much larger for the long paragraphs than for the short ones.

Recall was slightly lower for the many-different-argument paragraphs than for the few-different-argument paragraphs, though the difference was not significant. Apparently subjects read each paragraph until they felt they knew enough about it (with slightly higher criterion for the short paragraphs than the long ones), and then tried to recall it. Therefore, reading time and recall scores are difficult to interpret. Kintsch found a substantial difference for both long and short paragraphs; a many-different-argument proposition required about .4 second more of reading time for recall than a few-different-argument proposition. Kintsch notes that the time required to process a proposition was about the same for short and long paragraphs in Experiment 1.

In addition, there appears to be linear relationship between study time and amount recalled.

Propositions high in the paragraph structure were recalled better than subordinate propositions: level of proposition was a powerful determinant of recall.

Example :	The Greeks loved beautiful art.
Level 1 :	(Love, Greek, Art)
Level 2 :	(Beautiful, Art)

Subordinate propositions were recalled significantly better at all serial levels. A primacy effect was apparent only if the early piece of information was important for the text as a whole. (There was no evidence of a recency effect: subjects generally recalled the text in order).

Given the experimental design, it was not possible to separate the construction of text base repetitions from the surface repetitions. Theoretically, both types of effect must be expected. Since the task was one of immediate recall, subjects remembered surface features of the text in addition to its meaning. Hence, words that were repeated several times in atext should have a recall advantage.

Experiment 2 closely resembles Experiment 1, with the difference that reading materials were taken from Scientific American articles on the physical sciences. The same four basic types of paragraphs were used. (Short and long paragraphs with few- and many-different-arguments). Forty college students participated. The procedure and the scoring remained the same.

Results: Reading times were considerably longer for the many-different-argument paragraphs than for the few-different-argument paragraphs. Kintsch points out that the subjects made good use of the additional reading time, as their recall was just about equal for the difficult science paragraphs and the easy history paragraphs used in Experiment 1. Considerably less reading time is needed to recall a proposition if it is part of a text base in which only a few-different-argument. (This confirms the results of Experiment 1). Reading time per proposition recalled increased with the length of the paragraphs in Experiment 2 (unlike in Experiment 1). There was a positive correlation between reading times and number of propositions recalled.

Recall probability was again found to be a function of the level of the proposition in the text base and was again highly significant. Argument recall (as a function of the number of repetitions of an argument in the text base as well as repetitions of a word in the actual text) has strong (though not independent) effects upon the probability of recall.

Discussion: The first two experiments indicate that it is easier for readers to process and retain in memory a proposition that is built up from old, already familiar elements than to process propositions which introduce new concepts into the text. Propositions that contain new concepts require an additional processing step on the part of the reader. The number of different arguments in a text base is an important determinant of reading time and recall. Reading times were longer for the science paragraphs used in Experiment 2 than for the history paragraphs used in Experiment 1. Kintsch attributes this to the fact that the history paragraphs dealt with well-known stories, while the science information was new and therefore there was a smaller memory base available.

In Experiment 3 subjects listed to a presentation of the passages.

Method: Forty college students participated and were alternately assigned to a reading or listening group. The same stories used in Experiment 1 were tape-recorded by a male speaker. During the reading condition in Experiment 1 subjects read the many-different-argument texts more slowly than the few-different-argument texts though they recalled them almost equally well. In the listening condition few- and many-different-argument texts were presented at the same rate. The reading condition was the same as in Experiments 1 and 2 except that reading time was fixed and limited to the length of the tape recordings. The listening condition was the same except that a recorder was used instead of slides.

Results: The results were almost identical for the reading and listening groups. The average free reading time was about 10 seconds for short paragraphs and 21 seconds for long paragraphs. With experimenter controlled presentation 8 seconds were allowed for short paragraphs and 22 seconds were allowed for long ones. When reading times were subject controlled, they were longer for the paragraphs with many-different-arguments than for the paragraphs with few-different-arguments. This was not the case here, and results show that on the average few-different-arguments were recalled 8% better than many-different-argument paragraphs (compared to 4% better during subject controlled readings).

The detailed pattern of recall was largely the same after reading and listening ($r = .86$). The authors conclude that the results for reading and listening were equivalent, and that general features of comprehension and memory are being studied here, rather than reading-specific ones.

Kintsch points out that the equivalence between learning from reading and listening may break down for poor readers, but this study seems to show that the skill of learning by listening is essentially the same and forms the basis for the skill of learning by reading (Huey, 1908; Sticht, 1972).

Experiment 4 was designed to determine which propositions can still be recalled after 24 hours when memory for surface features of the texts is presumably quite weak. In previous experiments propositions at superordinate levels in the text base tended to be reported more frequently than propositions from subordinate levels; what happens after a delay?

Method: Twenty-six college students read the 12 experimental paragraphs which were preceded by two practice tests and returned 24 - hours later for a written recall test. The history paragraphs from Experiment 1 were used. When the subjects returned, they were given a recall booklet with a separate recall cue on each page. The recall cue was a statement based on the first, most superordinate proposition, of each text base (e.g., The Greeks loved art). Subjects had been told that they would be asked questions and were to read the paragraph at their own rate. During recall they were told to recall as much as they could about each paragraph, that recall did not have to be verbatim, and that they were to use complete sentences. Propositions that served as recall cues were not scored.

Results: Few-different-argument paragraphs were read faster than many-different-argument paragraphs and the interaction of that effect with paragraph length was again present as in Experiment 1.

While delayed recall was much less than immediate recall, results for the four types of passages: few-different arguments short and long; and many-different-arguments short and long, were basically the same. An analysis of variance revealed a significant levels effect, a significant delay effect, and a significant interaction between level and delay. Delayed recall was best for superordinate propositions and decreased directly with the decrease in the level of the propositions. Forgetting was, likewise, greatest for structures low on the hierarchy and was inversely related to the level of the proposition.

The authors tentatively conclude that the level of a proposition in a text base determines not only the likelihood that it will be successfully comprehended by the reader, but also the rate at which it will be forgotten. Arguments and words which were repeated were better recalled in both the delay and immediate conditions. As the authors point out earlier, however, these results are inconclusive because the two sets of statistics are not independent.

There was a striking difference between delayed and immediate recall: many of the delayed recall protocols contained more intrusions than reproductions. Differentiations between the experimental paragraph and the subject's knowledge about the subject matter broke down considerably with delay.

In summary the number of propositions in the text base that underlies a given text is an important determinant of the rate with which thetext can be comprehended and of the amount recalled. Text bases that include many different word concepts as arguments of propositions required more processing than text bases with few different word concepts, irrespective of the number of propositions. Reading time was found to be a function of the number of propositions processed, as indexed by immediate recall. The more superordinate propositions were recalled better than subordinate ones at all serial positions in the text. In addition to the levels effect on encoding, the data suggest that forgetting of the superordinate propositions occurred at a reduced rate.

The repetition of arguments and words increased recall; further research is suggested to separate the two effects. Memory was compared in reading and listening; when presentation time was kept constant, recall was the same. This data appear to be relevant to the comprehension process in general rather than to reading comprehension. It should be noted that reproductive, not reconstructive, aspects of recall were considered here. (Frederikson 1972, 1975 has developed a theory-based approach which is more concerned with reconstruction.) The authors suggest the interaction between a reader's knowledge base and the text he is reading as an interesting problem for further research.

Mandler, J.M., & Johnson, N.S. Remembrance of things parsed: Story structure and recall. Cognitive Psychology, 1977, 9, 111-151.

Mandler and Johnson propose a "grammar" for a simple story. It is assumed that the "story schema" or "idealized internal representation of the parts of a typical story and the relationships among parts" which is presented here, is the type used by readers to guide their comprehension. In brief, the story grammar parses the story into setting, events or states, episodes, goals, attempts, outcomes, ending, etc. (cf. Table 1 for a complete description).

According to Mandler and Johnson, correct temporal ordering of recall is dependent upon the degree of structure present in prose. They also believed that stories have a higher degree of structure than other types of prose passages. (The structure of stories is determined in terms of their story grammar.)

Piaget (1926) and Fraisse (1963) assumed that temporal inversions found in young children's recall were due to a failure to comprehend chronological, causal and deductive relations. A. Brown (1975) points out that failure to recall a story in correct temporal order could be due to lack of expository skills rather than a true failure to comprehend. Brown (1975a) points out that children could recall stories and plots of television cartoons. Mandler and Johnson suggest studying the effect of structure of simple stories upon recall before drawing conclusions about children's reproduction of temporal and causal sequences.

Method: Three of the four stories which the authors used are presented (pp.119, 121, and 124). Two of the four stories (one is on page 124) were taken from Piaget (1926) with modifications. The subjects were 21 students from each of the first and fourth grades and college. Eight first-graders and four fourth-graders who were unable to recall one or two stories were replaced. Elementary school children attended Public School in a middle-class district. Stories were tape recorded with equal emphasis given to all propositions.

Each subject recalled 2 stories. For the first story, recall was tested after a ten minute unrelated visual recognition task. Recall for the second story was measured after a 24 hour delay. Subjects were informed that a recall task would follow and were individually tested. First and fourth graders retold the story to a familiar adult who was not present during the original telling.

Four scorers were used. Since the experimenters were interested in the structural characteristics of recall rather than the egocentric use of pronouns, a proposition was not scored as missing if it included the incorrect pronoun. Incorrect use of pronouns occurred frequently among the first graders. These results are in accord with those of Piaget. Egocentric references were rare among the fourth grade and adult subjects. Protocols were not analyzed unless one or more propositions from the story were recalled.

Scoring was based upon a number of criteria. First, texts were scored for the presence or absence of the specified propositions. Second, they were scored for inversions of sequence of propositions within and between basic nodes. (Basic higher level nodes are never directly expressed in stories but subsume terminal nodes which represent a state or event and typically correspond directly to some surface expression. A state may be external, i.e., a current condition of the word, or it may be internal, i.e., an emotion or a state of mind. An event is any occurrence or happening, and may also be external or internal. External events include actions of characters and changes of state in the world. Internal events include thoughts, plans, perception and forgetting. Nodes are connected by AND, THEN or CAUSE). Third, texts were scored for the inversions of clauses within propositions. Fourth, importations of new material (additions) were scored. Finally, two kinds of elaborate clauses were scored for presence or absence; "tempral bridges" (e.g., when he got home) and "why clauses" (e.g., so it would not break into crumbs).

Results: The recall protocols from the immediate and delayed recall conditions were highly similar for all three groups (X propositions recalled-immediate=.56, delayed=.61). No sex differences in recall were found. Every story had one or more propositions representing the six major nodes in the grammar: settings, beginnings, reactions, attempts (including actions), outcomes and endings.

Results using the strict criterion, in which all four scores agreed that the recalled proposition expressed the meaning of the relevant propositions in the story, are reported. Adults recalled significantly more than the fourth graders, who in turn recalled more than the 1st graders. Recall of the six kinds of nodes differed significantly, and adults and children recalled the various nodes differently.

A Bonferroni t-test breakdown of the age by node interaction showed that the recall of 1st graders formed two significantly different clusters: settings, beginnings, and outcomes were well recalled, while attempts, endings and reactions were poorly recalled.

A general description of first graders' protocols is that they mentioned one or more of the main characters, the event that got the story going, and the outcome that resulted, omitting the internal reactions of the characters or what they did, as well as the final ending of the story.

The fourth graders showed a similar pattern of recall, although there was no longer a significant differentiation between recall of attempts and outcomes. The adults recalled attempts almost as well as settings, beginnings and outcomes. Recall of endings and reactions still lagged significantly behind.

The findings indicate the similarities as well as the differences in the kinds of retrieval activity engaged in by children and adults. In general, adults recalled more; outcomes being the only node which did not show a significant age trend. The similar ordering among nodes in the three age groups suggests that even the younger subjects were sensitive to the structure of stories and have schemata which organize retrieval in a fashion similar to adults.

The main differences in the story schemata of the younger children seem to be the greater weight placed on outcomes than on attempts and an almost complete loss of reactions. The authors believe that the lack of recall does not primarily reflect a lack of comprehension. Rather, the schemata which young children use to organize their recall emphasize the outcomes of action sequences rather than the actions themselves or the internal events motivating them.

Three kinds of sequence inverstions in recall were scored. An inversion could occur between two basic nodes; that is, a proposition from a later node in the story could precede a proposition from an earlier node. Inversions could also occur between terminal nodes within a given basic node (basic nodes parse into terminal nodes) and in propositions themselves where the proposition contains more than one clause.

Sequence inversions were rare, which supports the hypothesis that well-structured stories produce well-ordered recall. The absolute level of sequential ordering was high for all groups with no significant difference between children and adults.

More sequence inversions occurred between propositions within basic nodes (6.3%) and between phrases within propositions (14.7%) than between basic nodes (2%). There were fewer sequence inversions within basic nodes than had been expected, in part because typically only one proposition from a node was recalled (it could not be scored as an inversion unless both parts were recalled). Of the inversions which did occur, most were between propositions connected by and and then.

First graders produced fewer additions than did the fourth graders and adults, but the additions they produced were often irrelevant and generally occurred when the child got lost in recall (Table 8, page 147).

Discussion: The goal of this research was to predict what people will not remember from connected discourse. The authors developed a story grammar to relate the surface structure of stories to the underlying structures on which schemata are based, stressing the "syntactic" aspects of stories (vs. detailed semantic content).

Some of the transformations discussed appeared not to have affected comprehension as much as recall. Data comparing recall by children and adults suggest that story schemata differ somewhat at various points in development, and that consequently there are qualitative differences in recall.

The data, according to the authors, do not support the conclusions of Piaget (1926) that young children jumble the order of a story; and the discrepancy is explained in terms of the degree of story structure. When a story is well structured, temporal recall will be more accurate.

Meyer, B.J.F. Identification of the structure of prose and its implications for the study of reading and memory. Journal of Reading Behavior, 1975, 7, 7-47.

In the past, passages have been classified in terms of readability measures which included such variables as sentence length, vocabulary density and rarity, and idea density (Chall, 1958). Meyer argues that these variables deal with the surface factors of prose, and are not concerned with the meaning of prose, or the manner in which content is organized to convey meaning. She suggests that the structure of a passage depicts the relationships among the content of the passage, and shows how an author has organized his ideas to convey his message. Therefore, the structure of a passage captures one of the primary attributes of prose and could be a useful variable on which to characterize passages.

The imagery or concreteness of the content of a passage may beanother dimension. Paivio (1968,1976); Juille and Paivio (1969); Anderson (1972); and Montague and Carter (1973) have found that the concreteness of words influences recall from lists of words, sentences, or prose. Thus, Meyer suggests matching reading passages to determine their equivalence in terms of structure and concreteness of content, as well as the more conventional measures of readability.

In addition to the problem of determining the equivalence of prose passages, is the problem of scoring what is remembered from passages. Verbatim recall and substantive recall of ideas have been tried. Meyer suggests identifying units for substantive recall by analyzing the structure of a passage. These units are defined and identified by their relationship to the organizational structure of a passage. Content units and relationship units, called the content structure, are identified. Each content unit and relationship unit can be scored as present or absent in a particular recall protocol. This procedure, for judging absence or presence of content and relationship units, yields high scorer reliability (99% agreement).

Meyer also addresses the problem of developing comprehension questions: there is often disagreement among what different evaluators would identify as questions requiring main ideas and those requiring detailed information. Anderson (1970) analyzed 130 articles where experimenter-made achievement tests were employed, and found that two-thirds of the investigators did not describe what their questions were tapping. McConkie, Rayner, and Wilson (1973); McConkie and Rayner (1974); and McConkie and Meyer (1974) conducted research on the effects of various reading instructions on a person's reading strategy and what he subsequently learns from a passage; the problem of developing reading comprehension questions is again seen here. Since natural prose is complex, it has been difficult for researchers to agree on the kinds of information that prose questions tap.

Bormuth (1970) and Anderson (1972) have addressed this problem. The types of questions they used included verbatim and reordered verbatim questions, paraphrased and reordered paraphrased questions, and questions formed by substituting general terms for specific terms. Meyer, however, suggests using her tree structure to develop reading comprehension questions. She presents procedures to depict the content of a passage in a tree structure. Ideas high in the structure correspond to main ideas, while ideas low in the structure correspond to detailed information. Meyer suggests using the height of ideas in the structure of a passage to define the kind of information a question is to tap; this should eliminate the subjectivity of item writing. Crothers (1972; 1973); Fredericksen (1972, 1973); Spencer (1973); and Meyer (1971, 1974) have all attempted to analyze the organization of information in prose. The difference among the four approaches is discussed fully in Meyer (1974).

Meyer analyzes prose according to the basic tenets of Grimes; (1972, 1974) semantic grammar of propositions. Prose analysis yields hierarchically-arranged tree structures. The nodes in the tree structures contain the content words from a passage; labels state and classify the relationships among the content. The structure of a passage is referred to as the content structure, since it shows the structure of the content of a passage previously called logical structure (Meyer, 1971) and semantic structure (Fredericksen, 1972). The content structure of a passage shows how some ideas are subordinate to other ideas in a passage and specifies the relationship among ideas (cf. Section 3 for a complete description of Meyer's content structure).

Two studies were conducted which examined the relationship between aspects of the content structure and what people remember from the passages (Meyer, 1974). The first study investigated the effect of the height of information in the content structure of a passage, and the frequency of recall of the information by a group of people after reading the passage. The second study examined the degree of correspondence between content and relationship units recalled by readers from passages with the same structure and relationships, but different content. Recall protocols were scored on the basis of the presence or absence of content units and relationship units in each passage's content structure.

In the first study, the effect of the height of information (high or low) in the content structure of the passage on recall was studied by examining six passages, two of each topic. A target paragraph occurred in both conditions. In the high condition this was a paragraph which, when analyzed, made the target paragraph stand on the top of the content structure. The reverse was true for the low condition. The composition and location of the target paragraph was constant.

Two groups of 24 Cornell undergraduates participate. Group 1 was presented with the following paragraphs: Breeder Reactor High, Schizophrenia Low, and Parakeet High. Group 2 was given these paragraphs: Breeder Reactor Low, Schizophrenia High and Parakeet Low. Order of presentation was counterbalanced within groups. Subjects produced a written free recall for each passage immediately after reading it. Delayed recall, after one week, was also examined. There was, in addition, a cued recall condition in which subjects were given lists of the content words found in the target paragraphs, and asked tc produce a third free recall of each passage using the words to aid them.

The following results were obtained: (1) Information high in the content structure is more likely to be recalled; (2) information high in the structure is also more likely to be retained; and (3) under the cued recall condition one week after reading, the passages with information high and low in the content structure were recalled equally well. The content structure may help in guiding the reader's attention or in storage, thus allowing for better retrieval. Meyer suggests that the information low in the content structure may be rapidly lost from memory, or subsumed over time, rather than simply becoming inaccessible to free recall; otherwise, recall would have been facilitated under the cued recall condition and this did not occur.

Two practical implications from the data result. First, important ideas should be placed high in the content structure of instructional texts. Second, students who fail to detect interrelations among ideas in texts should be given experience with this type of text analysis, in which they are able to see the total structural pattern of a passage; this may aid them in reading.

A second study examined the degree of correspondence in recall patterns, from passages differing in the content of their content structures. Two passages with identical structures, but different content, were used. Meyer found a correlation of .55 between the recall frequency data of the units in the content structures of the two passages. The correlation between recall frequency of the two passages, when the units were high in the content structure, was .83. Meyer points out that, in contrast, information at the lower levels of the content structure is greatly influenced by aspects of particular content of specific units; numbers, for example, facilitated recall. The correlation between recall of the two passages when information was low in the content structure was .09.

According to Meyer, these results indicate that passages with identical structures of specific relations, but different content, produce similar patterns of recall. Meyer points out, furthermore, that the data from both experiments indicate that the structure of a passage, acquired by following the procedures she has outlined, relates to the information recalled from a passage.

Meyer suggests comparing content structures from recall protocols of good and poor readers, and also suggests examining protocols produced after reading for different purposes.

Meyer, J.F. The organization of prose and its effects on memory. Amsterdam:
North - Holland Publishers, 1975.

People tend to recall some aspects of text better than others. The research described here tried to determine which variables might account for these differences in recall.

Recent developments in linguistics, particularly case grammar and theories of discourse, have provided techniques for analyzing the structure of the content of a passage. An approach for analyzing the structure of the semantic content of a passage which Meyer developed is based on the discourse analysis method described by Grimes (1972). In addition to analyzing the semantic content of a passage, Meyer also analyzed the non-content aspects of a passage, which serve as guides to the reader by emphasizing certain aspects of the semantic content, or by pointing out the relationships stated in the passage more clearly.

According to Meyer, the structure of a passage depicts the relationships among the content of the passage, and reflects how an author of a passage has organized his ideas to convey his message. Therefore, the structure of prose captures a primary attitute of prose and is a useful variable on which to characterize passages. In the study presented the similarities and differences in the recall data from passages with identical structures, but different content, are examined.

Meyer (1971) defined and identified the substantive recall units by their relationship to the organizational structure of a passage. Meyer devised the hierarchical structure of the ideas in a passage by identifying a central idea from the passages, placing this idea at the tope of a tree structure, and placing at lower levels in the structure information that described or gave more information about this central idea. Ideas at the various levels in the structure became the idea units which were scored for their presence or absence in a recall protocol. In this study high level ideas correspond to main ideas, while ideas low in the tree structure correspond to detailed information. Meyer uses the height of ideas in the structure to define the kind of information a question should tap. Recall protocols were scored for presence of content or idea units arrived at by analyzing the structure of the content of the passage. Protocols were also scored for correctly relating together the content of the passage.

Halliday (1967, 1968) and Grimes (1972) have identified three distinct sets of relationships in discourse. The first system of relationships is the organization of the content in a passage. It is the structure of ideas in prose. The second set of relationships in discourse relates what is being said at the moment to what has already been said. It relates to how new information is introduced and how to help keep track of old information, for example, through pronouns. It also deals with a speaker's estimate of the rate at which his listeners can process new information. The third set of relationships in discourse is concerned with expressing the speaker's perspective of what information is being related. Halliday calls this system theme and Grimes labels it staging. (Grimes sees the speaker as upstaging or spotlighting the information). One way in which speakers might give an idea this kind of emphasis would be by placing it at the beginning of a sentence. Since previous research on structure in prose indicated that all of the variance in recall could not be accounted for by the content structure alone, Meyers also explores the influence which this latter set of relationships, theme or staging, has on the recall of information from prose. These non-content aspects of passages are called signaling by Meyer.

The prose analysis presented yields hierarchically arranged tree structures. Nodes in the tree structures contain content words from the passages, and the lines among the nodes shown spatially how the content is organized. Labels in the tree structure state and classify the relationships among the content. Hierarchical displays of a passage's content is called the content structure. This was previously called logical structure, Meyer (1971), and sematic structure, Fredericksen (1972). Ideas at various levels in the structure are content words and phrases from the text. Lower level ideas describe or give more detailed information about the ideas above them in the structure.

Labels which classify the relationships between content words are of two major types: role relations and rhethorical relations. Role relations are directly under certain types of content words in the content structure which dominate them. These special content words were some of the verbs and their adjuncts from the text in the passages studied. Special content words are called lexical predicates in Grimes' semantic grammar of propositions where predicate means relation. Grimes also calls rhetorical and role relations predicates. In prose, a predicate relates ideas together; in Grimes' terminology, it relates arguments together. Role relations classify the way lexical predicates relate to their arguments (other content words that are not lexical predicates). For example, some lexical predicates are related to the content they dominate by agentive roles and to other content by patient roles. Rhetorical relations or predicates are often found at the top levels of the content structure where they show how subordinate ideas are related together. For example, one idea might be a problem and the other a solution; the rhetorical relation used to level such relations between problems and solutions in text would connect these two ideas together. Grimes' calls such relationships between problems and solutions response rhetorical predicates. The response rhetorical predicate relates together two arguments, the content words representing the problem and those representing the solution.

Propositions discussed in Grimes' semantic grammar of propositions are composed of a predicate and its arguments. Arguments can be replaced by content words that are arguments of other propositions thus one proposition is often an argument of another more complex proposition. A rhetorical proposition has as its predicate a rhetorical predicate and as its arguments often lexical propositions or other rhetorical propositions. A rhetorical proposition is usually used to relate together larger segments of text than the segments of a simple sentence, and its arguments are often other propositions represented as sentences or paragraphs in the text.

The semantic grammar of propositions consists of two rules: a predicate rule and an argument rule. The predicate rule explains that a proposition is made up of a predicate or relation and its argument. Argument rules enable the grammar to produce or analyze prose of any complexity or length.

Lexical predicates are related to their arguments by specific semantic rules. Lexical predicates are often represented by nouns, verbs and their adjuncts that are actually present in a passage. Grimes distinguished between orientation lexical predicates and process lexical predicates. Roles of orientation lexical predicates communicate information about physical alignment, while roles of process lexical predicates communicate information about changes in state and the responsibility for such changes. Rhetorical predicates are not related to their arguments by specified rules. Rhetorical predicates are a small number of explicit organizing relations in prose. Paratactic predicates have at least two arguments of equal weight; for example, a passage stating a problem and its solution is organized by a paratactic rhetorical predicate called response with the two equally weighted arguments, problem and solution. On the other hand, hypotactic rhetorical predicates are not of equal weight. One argument is superordinate to other arguments that describe or give further information about it. An example would be a passage that states a problem and then gives more information about this problem where the statement of the problem is the superordinate argument and the subordinate argument provides further details about the problem. Neural rhetorical predicates can take either a paratactic or a hypotactic form depending upon the emphasis given to them by the speaker or author.

A number of psychologists have addressed themselves to analyzing the organization of information in prose. Crothers (1973) developed a structure which represented both the underlying structure of a passage and its representation in a competent reader's memory. Spencer (1973) created a scoring system to score recall protocols in order to index the degree to which the reader understood what he read. Frederiksen (1973) and Meyer (1973a) were concerned with developing structures which specified the content of passages in order to look at the similarities and differences between the structures and what readers could remember from passages. This, however, belies the difference between Frederiksen's and Meyer's approach. One major difference is that Meyer's structural hierarchy conveys the logic the author has established at both the lower and higher levels of analysis, while Frederiksen does so only at the lower levels. At the higher levels, Frederiksen can only relate the information found in different sentences.

Signaling (called theme by Halliday and staging by Grimes) is used by an author to highlight important points; it emphasizes certain aspects of semantic content, but is not included in content because it does not add new information. There are four types of signaling: (1) specification of the structure of relations in the content, i.e., explicitly stated rhetorical predicates; (2) prematurely revealed information abstracted from content occuring later in text, i.e., topics enumerated or information paraphrased at the beginning of the passages; (3) summary statement, i.e., paraphrase at end; (4) pointer words, i.e., if is important, unfortunately, etc.

Method: The subjects were 105 Cornell undergraduates. Twelve expositittory prose passages of about 575 words were used. Passages varied in terms of the height of the target paragraph in order to determine the relations between height and content remembered from prose. Two passages were written with an identical target paragraph such that this paragraph was high in the content structure of one passage and low in the structure of the other passage. There were six passages, two passages for each target paragraph topic and there were three topics. Another variable was signaling. The six original passages containing signaling, and the six versions with the signaling deleted, made up the set of twelve passages.

Similarity in content structure was maintained across passages. The number of signal words in the original passages was not controlled for and ranged between 14 and 144. Three additional short passages were used, as developed by Dames (1966), Crothers (1972), and Frederiksen (1972, 1973) and used in their own research.

There were two experimental sessions. In the first session, subjects read a series of passages and a written free recall test was administered. During the second session, one week later, two more recall tests were administered; for one, subjects wrote down everything they could remember about the passage, and for the second, they were supplied with content words from which they were to reconstruct the original passage.

The 105 subjects were divided into five groups and each read at least one high and one low passage. Four groups read the three long passages; two groups read with signaling and two without; and one group read only the target passages and the three short passages. Passages were read in counter-balanced order. Subjects were asked to recall information in sentence form so that the organization of the recall protocols could be examined. The content words for cued recall were drawn from the content structure of the target paragraphs. Idea units and relationships were scored.

Target paragraphs were either high in the content structure (the target paragraph corresponded to the main idea of the passage) or low in the content structure (the target paragraph corresponded to detail). Group x Passage interaction was significant: the paragraphs were recalled better high than low in the content structure of the passage. Meyer points out that the passages appear to be equivalent in recall difficulty and that the differences are due to height of idea units. There was also a significant difference in delayed recall of the target paragraphs embedded in the high and low passages with high being remembered better.

Meyer examined the mean differences between delayed free recall and delayed cued recall and found that cued recall helped recall of high and low paragraphs equally well. She concludes that poorer retention of information low in the content structure cannot be attributed to the fact that the information is actually present in memory and more difficult to retrieve after a week than information high in the structure. Rather, she attributes differences in retention of high and low passages to greater loss from storage of information low in the content structure. With the aid of cues, the differences in recall are still significant between the target in the high and low positions.

Other statistically significant effects and interactions include the Signaling x Order x Passage interaction, Order x Group x Passage interaction, and Passage x Subjects interaction (recall of target paragraphs on schizophrenia was superior to that of the target paragraphs or breeder reactors).

In terms of the implications of the effects of the height of information in the content structure for improving reading, Meyer suggests the use of a tree structure to help students understand the nature of the information presented, i.e., to point out super- and subordinate ideas. She also suggests determining if good or poor readers differ in the type of information they recall. It is possible that poor readers do not identify top level interrelationships of a passage.

Group x Passage interaction was significant. When the target paragraph was read alone (not embedded in the passage) 54% of the total number of units were recalled. When it was embedded, but placed high in the structure, 36% of the units were recalled and when low, 23%. Recall for content from with-signaling passages and from without-signaling passages did not differ significantly. Meyer did find that passages with identical structures of specific relations, but different content produce similar patterns of recall.

Meyer also notes that at the top of the content structure the pattern of relations has a very strong effect on what is recalled, while at the bottom of the structure what is recalled is determined almost entirely by aspects of the particular content of the sepcific units. The data presented here support the notion that organization in prose influences what idea units will be recalled. She suggests, as an explanation for these recall data, that readers rehearse and store in long-term memory that information most centrally related to the information organized at a higher level in a passage. Peripherally related information is rehearsed less in short-term memory, and what information is processed tends to be particular clusters of content that catch the reader's attention.

As Meyer indicated, signaling effects did not show up in this study. She points out that the proficient recall of information at the top of the content structure occurred whether or not it was signaled. Meyer also points out, however, that there was evidence that signaling aimed at the middle levels of the content structure increased recall substantially. Anticipatory lists of topics to be discussed appeared to represent the most effective type of signaling investigated in the study. (There is also some indication that signaling robbed attention from nonsignaled information low in the content structure and reduced its recall).

Ideas high in content structure seem to be remembered better. There are a number of possible explanations: (a) those ideas were repeated more often; (b) they are central ideas and subsume in memory ideas located low in the structure; (c) ideas from high and low positions are stored in memory but those from high structural positions are more accessible for retrieval (retrieval mode); (d) a selection process in reading could account for the data - readers tend to select ideas high in the content structure for processing into long-term storage rather than low level ideas. According to Meyer the models of sub-sumption, retrieval, and selection can each explain some of the findings but fail to explain others.

Olson, D.R. Language use for communicating, instructing, and thinking. In J.B. Carroll & R.O. Freedie (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C.: Wilston, 1972.

Olson recognizes two different uses of language. One is "sentences as descriptors", which is developmentally prior and underlies the ordinary use of language for communicating and instructing. The second is "sentences as propositions", and underlies such verbal acts as justifying and propositional thinking.

The category "sentences as descriptors" involves mapping sentences onto perception. There are a number of ways in which sentences map onto perceptual context: for instance, speakers choose descriptors based upon what they wish to differentiate. A small white block might be referred to as "the white one" or the "small one" depending on whether it appears together with a black block or a large white block. Olson points out that an account of reference, however, is not an account of meaning. The Morning Star and the Evening Star, for example, have the same referent (Venus) but different meanings. Meaning can be based upon critical attributes, the semantic features, but only some of these are explicitly marked in language. (Olson points out that semantic features are a subset of perceptual features (e.g., the feature striped, is both a perceptual and semantic feature of zebra).) Considering meaning in this way, implies that meanings are taught by defining the outer perimeters of words (a learner must know what a word is and what it is not). Olson suggests that words serve as retrieval cues for previous occasions when the word was the differentiated from some concept. Thus, he says that, "...language drags a context with it that forms the frame of reference for subsequent experience." In addition, Olson suggests that language is less ambiguous than pictures because a picture does not distinguish between, for example "cat, animal and Felix." However, he also points out that some perceptual events cannot be marked by language. Olson indicates, for example, that it would be impossible to draw a barnacle from a verbal description alone.

Considering the development of language, Olson points out that young children's statements are difficult to understand out of context. Dependency upon context and perceptual features decreases with age (De Laguna, 1927). He cites research by Ford (1971) and B. Randhawa (in press) which support this view.

and Spontak (1969) who found that first graders could generally comprehend active and passive sentences, but not until second grade could. Children perform above chance in determining equivalence between active and passive sentences. According to Olson, this implies first, that the surface structures of passive sentences may not be learned as a transformation of the base structure shared by the active sentence. Rather it may be learned as a new surface grammatical device appropriate for handling certain kinds of information. Second, since young children cannot recode active and passive sentences into their common base structure to judge equivalence, they must be able to verify or comprehend these sentences by recoding the pictures. Bem (1967) shows that when young children were taught to visualize the end-state given by a description, their performance greatly improved. The children, it seems, could not recode the sentence but could recode or visualize the perceptual end-state specified by the sentence. Olson cites a study indicating that the pattern for relational terms "more" or "less" is similar (Donaldson & Wales, 1970). Children can verify both "A has more than B" and "B has less than A" against the same picture before realizing that the sentences imply each other.

Olson, D.R. From Utterance to text: The bias of language is speech and writing. Harvard Educational Review, 1977, 47, 257-281.

Texts, according to Olson, are explicit written prose statements, while utterances are informal oral-language statements. Olson's argument is that there is a transition from utterance to text, both culturally and developmentally; and that this transition can be described as one of increasing explicitness, Olson indicates that the processes of mapping sentences onto perception is complicated: perceptual processes very often occur outside of a linguistic context; therefore, the perceptual world is moredifferentiated than the linguistic world indicates. Furthermore, Olson expresses the view that language comes to reflect a wider and wider context. Since sentences reflect accumulated context, a small number of sentences, reflects a much larger number of perceived contexts.

Olson presents a number of hypoteses on sentence comprehension based upon the relation he perceives between perception and language. Briefly stated, they are: (1) a sentence is comprehended relative to a context; (2) sentences which are compatible with their contexts (their presuppositions) are more easily processed; (3) if not compatible, either the context or the sentence must be recoded so that they do correspond; (4) perceptual contextual events are more easily recoded than sentences; (5) ease of comprehension depends upon the number of alternatives among which the reader must choose.

Olson cites a number of studies which measure the verification time of active and passive sentences to corresponding pictures. This interaction between the coding of the event and the grammatical form of the sentences indicated that the ease of comprehension depended upon the perceptual coding of the previous event (e.g., when the preceding picture was coded in terms of the receiver, passive sentences were moreeasily processed). In addition, comprehension proceeded on the basis of the surface structure of the sentence (passive vs.active). The number of alternatives available also seems to affect comprehension. In one experiment conducted by Olson (Olson & Filby, in press), subjects were asked to verify a sentence against either two or four multiple choice alternatives. Verification was faster when there were less alternatives.

Thus, Olson concludes that comprehension reflects both the structure of the information in the context and the number of alternatives from which the subject must choose.

Olson also considers mapping sentences onto sentences: sentences as propositions. A variety of sentences map onto other sentences such as those involving grammatical transformations (e.g., passive, negatives, questions). According to Olson, these sentences are basically equivalent and, therefore, thought to have a common underlying base structure. He develops the hypothesis that the recognition of this equivalence among sentences: (1) is more complex than ordinary communication about the world; (2) is developmentally late; (3) allows for language use in logics, theorizing, justifying and thinking; and (4) is a candidate for a revised conception of base structures (base structures are those structural invariants, or implicational relations among sentences).

There is some evidence that the ability to transform sentences develops later in children than the ability to transform perceptions. Trabasso (1970) reinterpreted Siobin's (1966) data and indicates that when adult subjects are given a negative sentence before being shown a picture, they transform the sentence to its affirmative equivalent. Young children, however, cannot recode or transform negative sentences into affirmative ones. (Siobin, 1966, as cited by Trabasso, 1970). Examining Siobin's (1966) data for passive sentences, it appears that adults do not recode passive sentences into active ones, while children, 6- to 10-years-old, found true passive (TP) sentences easier, indicating that they do transform passive sentences during verification tasks.

Olson suggests that perhaps younger subjects recode the picture while older subjects recode the sentence. This interpretation is supported by Beilin

Winograd, T.A. A procedural model of language understanding. In R.C. Schank & K.M. Colby (Eds.), *Computer models of thought and language*. San Francisco: Freeman, 1973.

Winograd explores the interconnections between the different types of knowledge required for language understanding. His computer program makes use of a detailed world model describing the current state of a block world, its knowledge of procedures for changing that state and making deductions about it. The model is a symbolic description, abstracting those aspects of the world relevant to operations used in working with it and discussing it. The meaning of any concept depends upon its interconnections with all other concepts in the model (most formal approaches to language avoided this characterization of meaning, i.e., logic and mathematics). The computational approach to modelling cognitive processes is able to deal with this sort of formalism. Rather than prove things about meaning, procedures are designed which operate with the model and simulate the processes involved in human use of meaning. The basic view underlying the model is that all language use can be thought of as a way of activating procedures within the hearer. Interpretations of the hearer are determined by his knowledge of the world, his expectations about the person talking to him, and his goals, etc. To prevent the computer program from being too structured, Winograd provided an internal language that contains the appropraite looping and checking as its primitives, and in which the representation of the process is as simple as the description. (Therefore, procedural representations for a variety of descriptions can be written.)

There must exist ways for the computer program to interpret the meanings of individual words (semantic analysis) and the syntactic structures in which they occur when given an English input. Definitions are based upon the use of semantic markers, i.e., a table is inanimate, 'pick-up' requires an animate subject. Definitions are not static rules but calls to program, for example, "Pick up your toys" is interpreted by the computer as put them all into the box. The semantic system must be able to check if an object is singular or plural. The program must also be able to distinguish if a particular object which the hearer is expected to know about (given information), is being referred to, i.e., the pyramid, and it does this by keeping track of when in the dialogue something has been mentioned.

Part of the relevant input in the process of semantic interpretation is the syntactic structure of the sentence. To provide this, the program contains a parser and a fairly comprehensive grammar of English. Systematic theory views a syntactic structure as being made up of units, each of which can be characterized in terms of the features describing its form, and the functions it fills in a larger structure or discourse. A grammar must include a specification of the possible features a unit can have (e.g., plural, subject, determiner, etc.), and the relations of these to both the functions it can play, and the functions and constituents it controls. These features form a highly structured system. One must decide if a clause is major or secondary; if it is a major clause one must decide if it is declarative, interrogative, etc. Thus, there is a choice between certain features, and depending upon the selection made from one set, one must choose between certain others. The grammar also requires realization rules (which describe how a given set of choices would be expressed in the form of surface syntactic structures) and interpretation rules (which describe how a string of words is analyzed to find its constituents and their features). The model is based on the belief that the basic ideas of programming such as procedure and subprocedure, interaction, recursion, etc. are central to all cognitive processes, and in particular to the theory of language. What is needed is formalism for describing syntactic processes.

These different types of knowledge are represented and used. There is the data base of assertions and PLANNER procedures which represent the knowledge of the physical world; there are semantic analysis programs which deal with problems such as reference; and there is a grammar which determines the syntactic structure. Effective language communication is a function of the way these areas interact.

Winograd points out that there are a number of limitations to the program he presents. One limitation is that the program does not attempt to handle hypothetical or counterfactual statements; it only accepts a limited range of declarative information, and it cannot talk about verbal acts. Another limitation has to do with the fact that human language understanding is a coordinated process in which a variety of syntactic and semantic information can be relevant, and in which the hearer takes advantage of whatever is more useful in understanding a given part of a sentence. The system presented here models this coordination in its order of doing things, by carrying on all of the different levels of analysis concurrently, although it does not model it in the control structure. Another shortcoming of the model is in not dealing with all of the implications of viewing language as a process of communication between two intelligent people.

BIBLIOGRAPHY

Anderson, R.C. The notion of schemata and the educational enterprise: General discussion of the conference. In R.C. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Berliner, D.C., & Rosenshine, B. The acquisition of knowledge in the classroom. In R.C. Anderson, R.J. Spiro, & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Betts, E.A. Reading is thinking. The Reading Teachers, 1961, 15, 179-184.

Bever, T.G. Perceptions, thought and language. In R.O. Freedle and J.B. Carroll (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C.: V.H. Winston, 1972.

Bloom, B.S. (Ed.) Taxonomy of educational objectives. Handbook I: Cognitive domain. New York: Longmans, Green, 1956.

Bobrow, D.G., & Collins, A. Representation and understanding. New York: Academic Press, 1975.

Bransford, J.R., & Johnson, M.F. Considerations of some problems of comprehension. In W. Chase (Ed.) Visual Information Processing. New York: Academic Press, 1973.

Bransford, J.D., Nitsch, K.E., & Franks, J.J. Schooling and the facilitation of knowing. In R.C. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Brown, R. Words and things. Glencoe, Ill.: Free Press, 1958.

Carpenter, P.A., & Just, M.A. Integrative processes in comprehension. In D. La Berge & S.J. Samuels, Basic processes in reading: Perception and comprehension. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1977.

Carroll, J. Words, meanings, and concepts. Harvard Educational Review, 1964, 34, 178-202.

Carroll, J.B. Defining language comprehension: some speculations. In R.O. Freedle and J.B. Carroll (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C.: V.H. Winston and Sons, 1972.

Chafe, W.L. Creativity in verbalization and its implications for the nature of stored knowledge. In R.O. Freedle (Ed.), Discourse processes: advances in research and theory. Vol. 1. Norwood, N.J.: Ablex, 1977.

Chall, J. Learning to read: The great debate. New York: McGraw-Hill, 1967.

Charniak, E. A framed painting: The representation of a commonsense knowledge Fragment. Cognitive Science, 1977, 4, 355-394.

Clark, E. What's in a word? On the child's acquisition of semantics in his first language. In T.E. Moore (Ed.), Cognitive development and the acquisition of language. New York: Academic Press, 1973.

Clark, H.H. Inferences in comprehension. In D. La Berge & S.J. Samuels, Basic processes in reading: Perception and comprehension. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1977.

Collins, A. Processes in acquiring knowledge. In R.C. Anderson, R.J. Spiro & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Davis, F.B. Psychometric research on comprehension in reading. Reading Research Quarterly, 1972, 7, 628-678.

Deighton, L. Vocabulary development in the classroom. New York: Teachers College Press, 1959.

Dreshner, E. and Hornstein, N. On some supposed contributions of artificial intelligence to the scientific study of language. Cognition, 1976, 4, 321-398.

Frederiksen, C.H. Representing logical and semantic structure of knowledge acquired from discourse. Cognitive Psychology, 1975, 7, 371-458.

Gibson, E.J., & Levin, H.L. The psychology of reading. Cambridge, MIT Press, 1975.

Golinkoff, R.M. A comparison of reading comprehension processes in good and poor comprehenders. Reading Research Quarterly, 1975-1976, 11, 623-659.

Guthrie, J.T. Story comprehension. The reading teacher, 1977, 30, 574.

Hurtig, R. Toward a functional theory of discourse. In R.O. Freedle (Ed.), Discourse processes: advances in research and theory. Norwood, N.J.: Ablex, 1977.

Kintsch, W. The representation of meaning in memory. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1974.

Kintsch, W. Memory for prose. In C.N. Cofer (Ed.), The structure of human memory. W.H. Freeman, 1976.

Kintsch, W. On comprehending stories. In M.A. Just & P.A. Carpenter (Eds.), Cognitive processes in comprehension. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Klare, G.R. The measurement of readability. Ames, LA.: 1963.

Kolers, P.A. Three stages of reading. In H. Levin & J. P. Williams (Eds.) Basic studies on reading. New York: Basic Books, 1970.

MacGinitie, W.H. Research suggestions from the "Literature Search". Reading Research Quarterly, 1975, 11, 7-35.

McCullough, C. Package, ritual, and insight. Reading Teacher, 1972, 390-394.

Meichenbaum, D. Cognitive-functional approach to cognitive factors as determinants of learning disabilities. In R.M. Knights & D.J. Bakker (Eds.), The neuropsychology of learning disorders: Theoretical approaches. Baltimore, Md.: University Park Press, 1976.

Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.

Nelson, K. Concept, word, and sentence: interrelations in acquisition and development. Psychological Review, 1974, 81, 267-285.

Olson, D.R. Language use for communicating, instructing, and thinking. In J.B. Carroll & R.O. Freedle (Eds.), Language comprehension and the acquisition of knowledge. Washington, D.C.: Winston, 1972.

Olson, D.R. From utterance to text: The bias of language in speech and writing. Harvard Educational Review, 1977, 47, 257-281.

Otto, W. Design for developing comprehension skills. In J. Guthrie (Ed.), Cognition, curriculum and comprehension. Mewarl. Del.: IRA, 1975.

Paris, S.G., & Lindauer, B.K. Constructive aspects of children's comprehension and memory. In R.V. Kail & J.W. Hagen (Eds.), Perspectives on the development of memory and cognition. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1977.

Robinson, H.A. Teaching reading and study strategies: The content areas. Boston: Allyn and Bacon, 1975.

Ross, A.O. Psychological aspects of learning disabilities and reading disorders. New York: McGraw Hill, 1976.

Rubin, A.D., Bruce, B., & Brown, J.S. A process-oriented language for describing aspects of reading comprehension. Technical report Center for the Study of Reading. University of Ill. at Urbana-Champaign, Oct., 1976.

Rubin, A.D. A theoretical taxonomy of the differences between oral and written language. In R.J. Spiro, B.C. Bruce & W.F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, N.J.: Lawrence Erlbaum Associates.

Rumelhart, D.E., & Ortony, A. The representation of knowledge in memory. In R.C. Anderson, R.J. Spiro, & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Schank, R.C. The role of memory in language processing. In C.N. Cofer (Ed.), The structure of human memory. W.H. Freeman, 1976.

Simmons, R.F. Semantic networks: their computation and use for understanding English sentences. In R.C. Schank and K.M. Colby (Eds.), Computer models of thought and language. San Francisco: W.H. Freeman, 1973.

Spiro, R.J. Remembering information from text. In R.C. Anderson, R.J. Spiro, & W.E. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

van Dijk, T.A. Semantic macro-structures and knowledge frames in discourse comprehension. In M.A. Just & P.A. Carpenter (Eds.), Cognitive processes in comprehension. Hillsdale, N.J.: Lawrence Erlbaum, 1977.

Vellutino, F.R. Alternative conceptualizations of dyslexia: Evidence in support of a verbal-deficit hypotehsis. Harvard Educational Review, 1977, 47, 334-354.

Weaver, P.A. Comprehension, recall, and dyslexia: A proposal for the application of schema theory. Bulletin of the Orton Society, 1978, 28.

Wiig, E.H., & Semel, E.M. Language disabilities in children and adolescents. Columbus, Ohio: Merrill, 1976.

Winograd, T. A procedural model of language understanding. In R. C.Schank & K.M. Colby (Eds.), Computer models of thought and language. San Francisco: W.H. Freeman, 1973.

Winograd, T. A framework for understanding discourse. In M.A. Just & P.A. Carpenter (Eds.), Cognitive processes in comprehension. Hillsdale, N.J.: Lawrence Erlbaum, 1977.